Assessment

Forest Plan Revision

Draft Aquatic and Riparian Ecosystems Report

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Introduction

This report addresses aquatic ecosystems, including surface water, riparian and groundwater resources, on the Custer Gallatin National Forest. The relative representation of these ecosystems on the Custer Gallatin, their condition, and information gaps are summarized, as well as current management direction. Finally, the importance of these results and how they could contribute to a revised forest plan is discussed.

An ecosystem is defined as a spatially explicit, relatively homogeneous unit of the earth that includes all interacting organisms and elements of the abiotic environment within its boundaries (FSH 1909.12 zero code p 7) – by extension, aquatic and riparian ecosystems are those directly associated with water and water-related vegetative habitats. In general, lakes and rivers (including streams of all sizes) are considered surface waters and are the aquatic ecosystems with which most people commonly interact and which directly provide ecosystem and other services. However, most surface water directly or indirectly depends upon groundwater to maintain flow and other functions—ground water-dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes depend on ground water (USDA Forest Service 2007). Riparian areas are the transitional zones between aquatic and terrestrial environments found along streams, lakes and wetlands (36 CFR 219.19), manifest by plant communities reliant on water, but whose presence is also critical to structuring and stabilizing aquatic habitats (stream habitats, streambanks, and groundwater recharge; Poff et al. 2012). Although usually less than 2 percent of the area of any given western U.S. landscape, riparian areas provide the majority of biodiversity on a landscape because of their structural diversity and ecotonal nature (Poff et al. 2012). The reciprocal interaction between surface water, groundwater, and riparian areas is why these intertwined ecosystems are considered together in this report. Thus, generally all three ecosystems (surface waters, riparian areas and groundwater-dependent ecosystems) will be grouped as aquatic and riparian ecosystems because of their shared reliance on water. This report also addresses aquatic and riparian ecosystem integrity of Custer Gallatin watersheds, which is the degree to which natural ecological composition, structure and processes are essentially intact and self-sustaining. Intact ecosystem integrity indicates that an ecosystem is able to evolve naturally with its capacity for self-renewal and biodiversity maintained.

Surface water resources are reasonably well studied across the Custer Gallatin, with some exceptions that will be addressed. Surface waters fall into two broad categories: lentic, or non-flowing, waters (lakes, ponds), and lotic, or flowing, waters (streams, rivers). Properly functioning condition assessments help determine priority areas to focus improvement activities and have been assessed in both lotic and lentic systems in the grazing allotments of the Montane and Pine Savanna units over the past two decades. Long-term trend studies have been established and some reread in the last decade in the majority of allotments found in the Montane riparian areas. Groundwater systems have historically had less research and management than surface water systems worldwide, and this is true for the Custer Gallatin. In addition to groundwater-fed lakes and streams, which are included in the surface water discussion, groundwater habitats include aquifers, seeps, fens, springs, cave and karst systems, hyporheic (wetted area beneath and alongside a stream bed, where there is mixing of shallow groundwater and surface water) and hypolentic zones, and wetlands (wetted area beneath lakes and wetlands).

Custer Gallatin aquatic and riparian ecosystems fall within three broad ecoregions (EPA 2013):

- Middle Rocky Mountains, inclusive of the Custer Gallatin's Bozeman, Hebgen Lake, Yellowstone, Gardiner, and Beartooth Ranger Districts (hereafter referred to collectively as Montane ecosystems or units; (Figure 1),
- Great Basin, inclusive of a small portion of the Pryor Mountain Range foothills on the Beartooth Ranger District, and
- Northern Great Plains, inclusive of the Ashland and Sioux Ranger District (hereafter referenced as 'Pine Savanna' ecosystems/units – although this is an upland ecosystem descriptor with little relevance to aquatic and riparian ecosystems, it is socially iconic; (Figure 2).

For this report, we will primarily refer to Montane and Pine Savanna units because patterns within aquatic and riparian ecosystems are most usefully summarized within these settings.

The Custer Gallatin contains the broadest diversity of aquatic and riparian ecosystems and species in the Northern Region of the Forest Service—from glacial meltwaters to intermittent Pine Savanna streams. In addition to the ecosystem services they provide, these aquatic systems provide a variety of social and economic benefits to local, national, and international communities.

Physical and Hydrologic Setting

The Montane units occur in southwest and southcentral Montana (Figure 1), and include seven distinct mountain ranges: the Beartooth, Absaroka, Crazy, Bridger, Gallatin, Madison, and Henry's Lake Ranges. Each mountain range has distinctive features. The Absaroka and Beartooth Ranges are steep and rocky. They commonly include U-shaped glacial valleys, glaciated peaks, and high plateaus. The Crazy Mountains have a central core of steep, glaciated land but are surrounded by benches, ridges, and outwash plains, all of which have low relief. The Bridger Range is a long, narrow limestone ridge flanked by rolling foothills. The Gallatin and Madison Ranges contain ridges, steep stream-cut and glacial valleys, and broad, sloping benches. In the Henry's Lake Range, high plateaus dominate the southern and eastern parts of the range and steep glaciated landforms and outwash plains are in the northern and western parts.

This landscape is drained by five major rivers: the Yellowstone, Boulder, Shields, Gallatin, and Madison Rivers (Figure 1)**.** The Yellowstone River flows northeast from Yellowstone National Park. It follows a large, gently sloping valley between the Absaroka and Gallatin Ranges. The Boulder River flows northward from the Absaroka and Beartooth Ranges. The Shields River originates in the western part of the Crazy Mountains and flows south into the Yellowstone River, near the town of Livingston. The Gallatin River, which originates in Yellowstone National Park and flows northward, divides the Gallatin and Madison Ranges. The Madison River originates in Yellowstone National Park and flows west through Henry's Lake Mountains, near the town of West Yellowstone.

Surface flow regimes on the Montane units are largely perennial, although many headwater reaches are ephemeral and local geology can result in localized intermittent stream reaches. Average annual precipitation tends to range 20-30 inches, with a low of about 10 inches at Gardiner, and highs of over 40 inches at high elevations (High Plains Regional Climate Center, http://www.hprcc.unl.edu/). Across elevations in the Montane units, watershed hydrology is strongly dependent on timing and magnitude of seasonal snowmelt (generally occurring in April and May). For example, in the Beartooth District, an average of about 31 inches of precipitation falls at the Cole Creek SNOTEL site (elevation 7,850 feet), whereas about 30 inches of annual precipitation are received at the Burnt Mountain SNOTEL site (elevation 5,880 feet). However, the elevation difference between these two sites leads to a significant difference in the ratio of precipitation falling as rain versus snow; over 50 percent of Cole Creek's precipitation occurs as snow, whereas only approximately 13 percent of the precipitation falling at Burnt Mountain occurs as snow.

The Pine Savanna units occur in southeastern Montana and into northwestern South Dakota (Figure 2), and as such the physical and hydrologic characteristics are much different than the Montane units. Surface flow regimes throughout the Ashland and Sioux Ranger Districts are largely ephemeral and intermittent. Average annual precipitation is approximately 13-17 inches, with precipitation increasing to the east and at higher elevations (High Plains Regional Climate Center, http://www.hprcc.unl.edu/). While minor peak flows resulting from snowmelt are common, short duration high-intensity precipitation events (often from summer thunderstorms) can produce substantial peak flow events in small watersheds around the Ashland area. Such events have been documented in post-wildfire settings and in absence of wildfire (Parret et. al 2015; Efta 2014, 2015). This suggests that storm characteristics may have an overriding influence in some cases. While not well understood, sediment transport processes likely follow these sporadic flashy events; sediment delivery to and conveyance through draws and channels appears to be largely periodic and tends to occur in large pulses such as during debris flow events. Additionally, the magnitude of those events will depend on local hydrogeomorphic processes (the interaction of surface/subsurface hydrology and landforms) and the intensity and temporal scale of land uses both of which may vary greatly among drainages. Headcut initiation has been observed in numerous locations across the Ashland and Sioux Districts where between one and two-tenths of a square mile drainage area are contributing upstream. While headcuts are typically thought of as erosional features, there is uncertainty as to the degree which these features can be attributed to natural process versus human-caused activities in these streams because the observed pattern holds in most watersheds irrespective of land management. Below these headcuts, a transition to riparian or wetland vegetation is commonly encountered, generally signaling a decrease in water table depth relative to surface elevation.

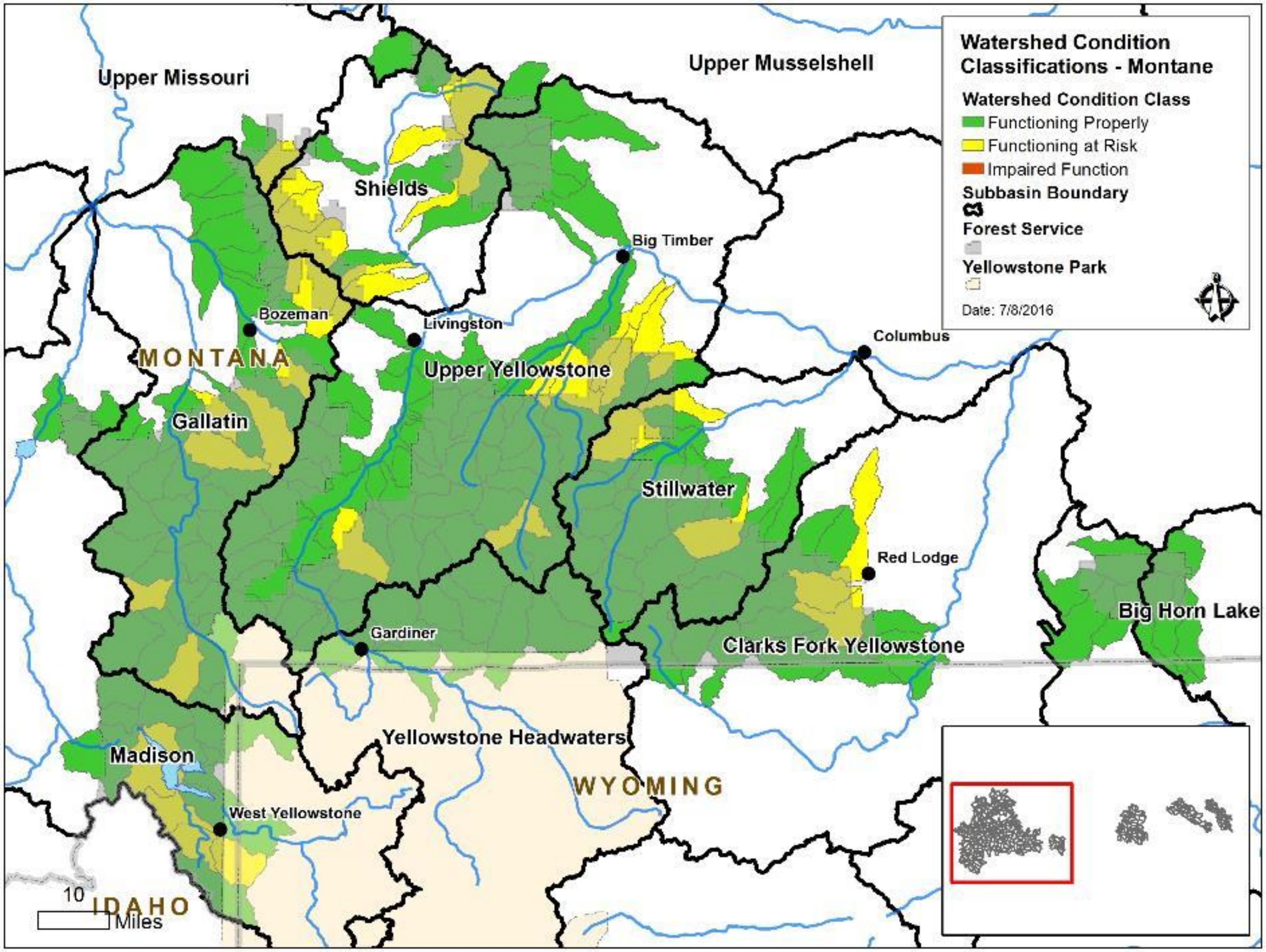

Figure 1. Custer Gallatin watersheds and condition class ratings on the west side of the national forest

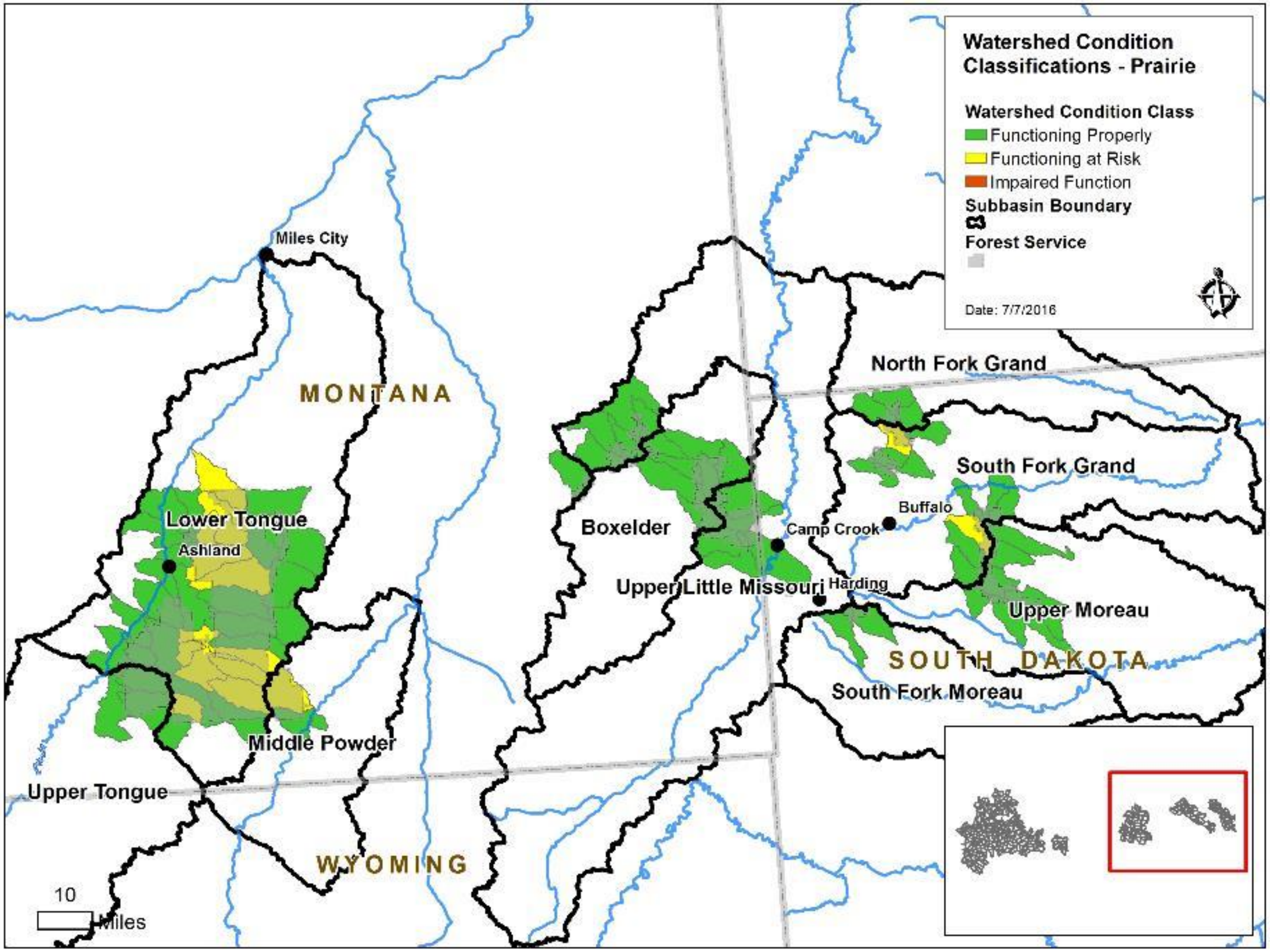

Figure 2. Custer Gallatin watersheds and condition class ratings on the east side of the national forest

Methods and Existing Information Sources

The 2012 Planning Rule directs national forest managers to maintain or restore the ecological integrity of terrestrial, riparian and aquatic ecosystems (36 CFR 219.8). The Planning Rule promotes ecological integrity through the maintenance and restoration of the ecological composition, structure, function, and connectivity across the national forest area. In preparation for plan development this assessment discusses current conditions and trends in terms of these components of ecological integrity.

Riparian and aquatic ecosystems are described in terms of composition, structure, function, and connectivity (36 CFR 219.8). Composition refers to the types and variety of living things, in this case the lifeform presence along with the type of species, native versus exotic, and the type of habitat (**Error! Reference source not found.**). Structure describes the physical distribution and character of elements that contribute to the function of ecosystems. This assessment uses stream channel shape and function in addition to the presence of large woody debris to address ecosystem structure. Given that riparian and aquatic species depend to varying degrees on sufficient water quantity and quality, this assessment uses these elements to describe function. The connectivity of both riparian systems and aquatic species is addressed as habitat fragmentation. Table 1 relates these ecosystem components to key riparian and aquatic ecosystems characteristics along with indicators used to measure condition. Some characteristics may be carried forward to inform Forest Plan components and/or long term monitoring plans depending on their relevancy to coarse and fine filter ecosystem diversity.

Table 1. Key riparian and aquatic ecosystem characteristics and indicators/measures

Key Characteristic	Indicator
Composition	
Life form presence	Presence of diverse riparian and aquatic life forms and communities
Native species	Presence of native species in historically occupied habitats
Exotic/invasive species	Presence of exotic/invasive species (plant and animal)
Aquatic habitat diversity	Presence of habitat and channel types (i.e. streams, lakes, wetlands, groundwater habitats, Rosgen channel types, aquatic ecological systems)
Riparian/wetland vegetation	Presence, lifeform, and dominance types of vegetation in riparian and wetlands (i.e. hydric/mesic/xeric, bare ground, etc.)
Structure	
Channel shape and function	Pool quantity and quality Beaver presence, potential Stream width-to-depth ratios Channel and streambank stability Substrate composition
Large woody debris	Quantity of large downed wood greater than 3 inches diameter, montane streams; potential recruitment (e.g. insect and disease, tree size)
Function	
Water quantity	Hydrograph departure from expected natural hydrography (e.g. human damming; riparian storage, groundwater extraction and recharge)
Water quality	Beneficial use attainment; riparian areas filtering sediments, stabilizing banks, etc.
Habitat fragmentation	Number of barriers impeding movement of biota and habitat elements within aquatic and riparian habitats (e.g. large woody debris, nutrients) Miles of stream artificially constrained or disconnected from floodplain access

Data used for summary and analysis of aquatic and riparian resources were compiled from data collected by Custer Gallatin staff, Forest Service research and monitoring programs, and interagency partners. The inference from the data used to evaluate the components of ecological integrity varies by the data spatial resolution and expanse. The interpretation brings in context from the scientific literature (best available science), agency reports, and professional judgment. The primary data sources used for this assessment include the following.

Pacfish Infish Biological Opinion (PIBO) Monitoring: This dataset, collected on the Montane units at 22 reference sites and 43 managed sites, allows rigorous comparison of aquatic habitat condition and trend between watersheds where active land management occurs and those where it does not (Henderson et al 2005). PIBO sites (n=22, managed) are also present on the Pine Savanna units, but data for these sites lack reference comparison. Trend data at these sites are being analyzed to determine best indicators of trend for Pine Savanna systems; trend for some habitat variables is available at 5 to 8 sites presently, depending on the variable. In addition to local Montane reference sites, the PIBO data include additional sites within the Middle Rockies ecoregion, as well as reference sites across the western United States.

Species Distribution: Aquatic species distribution data is compiled from databases maintained by the Custer Gallatin National Forest, Montana Fish, Wildlife and Parks (MFWP 2016), Montana Natural Heritage Program (MNHP 2016), South Dakota Game Fish and Parks (SDGFP; Chelsey Pasbrig, SDGFP, pers. comm.), and the Miles City Field Office, Bureau of Land Management (BLM; Christina Stuart, BLM, pers. comm.).

Aquatic Community Classification: In Montana, lotic aquatic habitats have been classified by the combination of their biota and physical habitat characteristics into 13 aquatic ecological systems (1:100,000 scale; Stagliano 2005) which will be used in this assessment to help categorize Custer Gallatin aquatic habitats. The classification system is based on the hierarchical arrangement of habitat, from broadscale (ecoregion) to midscale (ecological drainage units, aquatic ecological systems) to local (aquatic macrohabitats), combined with aquatic community species assemblages and their associations (Stagliano 2005). This classification, in turn, has been used by Montana Fish, Wildlife and Parks to identify three tiers of communities of greatest conservation need as well as specific focal areas for priority conservation (MFWP 2015). Tier 1 communities of greatest conservation need and focal areas are considered to be the highest priority for implementation of conservation actions. There are three focal areas that overlap with the Custer Gallatin including Shields River, Slough Creek, and Tongue River. The Shield River focal area, in the Yellowstone District, is a core conservation area for Yellowstone cutthroat trout. The Slough Creek focal area, on the Gardiner Ranger District, has an aboriginal population of Yellowstone cutthroat trout. The Tongue River focal area, on the western fringe of the Ashland District, has high fish diversity and is important spawning habitat for a number of prairie fish species whose range may extend onto the Custer Gallatin. South Dakota used a similar process, with slightly different nomenclature, to characterize South Dakota watersheds (SDGFP 2014), but focuses on the physical habitat hierarchy above the habitat unit scale. For the South Dakota portion of the Sioux Ranger District aquatic ecological systems developed for Montana were applied based on aquatic macrohabitat features and biota, so that aquatic ecological systems could be summarized in the same manner for the entire national forest. Similar to Montana, South Dakota used its watershed classification to identify aquatic conservation opportunity areas. None of the South Dakota aquatic conservation opportunity areas included Custer Gallatin watersheds (SDGFP 2014). Finally, the Great Plains Fish Habitat Partnership used fish species guilds to identify how various ecosystem drivers influence distribution of prairie fish, as well as to prioritize landscapes for their conservation and restoration (Cingerman et al. 2013). These guilds are similar to the 13 species assemblages used to develop the aquatic ecological systems for Montana streams, but rely on key species to indicate broader aquatic communities and habitat types. The four guilds (darter, madtom, northern headwater and turbid river) that apply to the portion of the Great Plains inclusive of the Custer Gallatin are considered in this assessment to provide context for those guilds and their habitats on the national forest as compared to the range of those guilds across the Great Plains (Clingerman et al. 2013).

Beaver Habitat Suitability: Beaver habitat suitability has been modeled for the Custer Gallatin (Great West Engineering 2016), to help biologists begin to understand the nexus between land management, other habitat variables, and opportunities for beaver restoration. In general, optimal habitat for beaver consists of reliable water supply, moderately high cover of winter food species (riparian trees and shrubs), and low energy stream and valley bottom morphology.

Natural Range of Variation: For the Montane units, current natural range of variation of aquatic habitat conditions are derived from the PIBO data collected at 22 reference locations. These reference data can also be compared to, and nested within, the broader Pacfish/Infish Biological Opinion (PIBO) reference dataset. PIBO reference sites do not exist on the Pine Savanna portion of the Custer Gallatin; thus, reference condition will be discussed in the context of biotic condition indices (Stagliano 2010).

Watershed Condition Framework: The Watershed Condition Framework (2011) establishes a consistent and comparable process for assessing the relative health and restoration prioritization of watersheds at the national forest unit scale. This framework provides a basis upon which the success of focused management efforts designed to maintain or restore watershed functions can be measured in a consistent manner. The framework establishes a nationally consistent reconnaissance-level approach to classifying watershed condition, using a defined set of 12 indicators whose scores represent the state of underlying ecological, hydrological, and geomorphic functions and processes that, operating together, characterize watershed function. Primary emphasis is on aquatic and terrestrial processes and conditions that Forest Service management activities can influence. Three overall ratings are possible for a watershed: functioning properly, functioning at risk, and impaired function, as a result of the same ratings summarized for all 12 indicators. On the Custer Gallatin we have found that to score functioning at risk, a watershed has required at least one watershed condition variable in impaired function, in addition to several (typically 8 or 9) variables functioning at risk. Watershed condition is assessed at the 12-digit hydrologic unit code (HUC12). The HUC12 watersheds that intersect, AND whose area is at least 5 percent on National Forest System land are assessed for conditions and trends from a watershed scale. These areas range from about 9,000 to 50,000 acres in size (**Error! Reference source not found.** and **Error! Reference source not found.**).

Region 1 Existing Vegetation database (VMap): Mapping of vegetation is based on the Region 1 Vegetation database (VMap). VMap is a geospatial dataset developed using the Region 1 Existing Vegetation Classification System (Barber et al. 2011). It is a remotely sensed product that is derived from satellite imagery, airborne acquired imagery, field sampling and verification. Detailed metadata for this database can be found in the project file.

Riparian vegetation classifications in the original existing vegetation database (VMap) do not include hydrological features; therefore, more refined riparian and wetland area data sources were incorporated using national wetland inventory data provided by the Montana State Natural Heritage Program, which also covered the South Dakota portion of the Sioux District. National wetland inventory maps riparian and wetland areas based on aerial imagery, hydrological feature mapping, soils, and vegetation layers. The Montana Natural Heritage Program layer represents a refined map of wetland resources down to one-tenth acre resolution based on aerial imagery and hydrological feature mapping.

Nine quads in the Gallatin portion of the assessment area have not been completed yet, but are anticipated for completion in the near future.

For the Montane units, national wetland inventory map data and a riparian extent model were included in VMap. Riparian extent was modelled by using a tool developed by Forest Service Washington Office personnel for the Montane units. The model uses a lakes/ponds feature class, DEMs, HUC12 watershed boundaries, and NetMap streams data whose parameters are applicable to hydrologic considerations of the Montane units. Locations within the modeled riparian area that did not intersect with national wetland inventory polygons were attributed with VMap data via intersection. Where upland vegetation was mapped within riparian corridors, the location was classified as a riparian corridor. The basis for this classification is that, although dominated by nonriparian vegetation, these locations were within stream terraces (about a 50-year floodplain) and in proximity to the stream such that processes occurring within them influence the aquatic systems and vice versa. For example, many of these locations were high gradient streams reaches with narrow floodplains, where conifers dominate the vegetated overstory, and whose recruitment to those stream reaches as large woody debris is critical for creation and maintenance of instream habitats (Rosgen 1996).

For the Pine Savanna Units, national wetland inventory map data and refined VMap Green Ash Woodland data (Biswas et al. 2012) were used for inclusion into VMap. Flow regimes and stream orders were used to differentiate between nonriparian Green Ash Woodlands and Riparian-Green Ash Woodlands. The riparian extent model used for the Montane Units was not used for the Pine Savanna units due to limited application of model parameters. However, national wetland inventory mapping is considered accurate for this land area, in part because steep headwater streams with narrow floodplains influenced by large woody debris recruitment are very rare on this landscape.

Custer Gallatin Riparian Data: The Custer Gallatin "In Stream" database was developed to house riparian and channel morphology monitoring data. Monitoring follows protocols outlined in the Custer Gallatin Riparian Area Monitoring Framework. The protocol uses a modification of PacFish/InFish Biological Opinion (PIBO) sampling protocols to inventory and monitor riparian vegetation. The Custer Gallatin Riparian Area Monitoring protocol and associated inventoried sites are not the same as the PIBO protocols and their associated inventoried sites and the two datasets should not be mixed together.

The Custer Gallatin National Forest protocol is designed for integrated sampling of channel morphology and aquatic and riparian habitat along stream reaches susceptible to livestock grazing. It provides an inventory that includes interpreting Rosgen classification (Rosgen 1996), proper functioning condition, and vegetation rapid assessment protocols, and an in-depth characterization of existing vegetative conditions for allotments programmed for out-year environmental analysis. It is also used as a baseline for long-term monitoring, which includes the Custer Gallatin Riparian Vegetation Sampling Protocol and the Channel Morphology Protocol. Data from this protocol are generally limited, at present, to grazing allotments on the Montane districts, where about 90 percent of the allotments have long-term monitoring sites (n=32) and where the bulk of the riparian resources occur.

Proper Functioning Condition data: Proper functioning condition is a methodology for assessing the functioning conditions of riparian areas (Dickard et al. 2015, Prichard et al. 2003, 1998). Proper functioning condition defines a minimum level or starting point for assessing riparian areas. Like riparian data, proper functioning condition is most often collected within grazing allotments as a way of understanding how grazing may be influencing riparian conditions.

Scale

A variety of spatial extents are used depending on the analysis element, in order of broadest to finest:

- Custer Gallatin National Forest (Custer Gallatin or assessment area): The assessment area covers approximately 3.4 million acres including private land inholdings.
- Montane and Pine Savanna Units: These two units depict ecologically different areas. The Montane unit includes the Hebgen Lake, Bozeman, Gardiner, Yellowstone, and Beartooth Ranger Districts and the Pine Savanna unit includes the Ashland and Sioux Ranger Districts.
- Landscape Areas: The Custer Gallatin is broken into five landscape areas ranging from roughly 78,000 acres to 2.3 million acres, including private land inholdings. These include (1) Madison, Gallatin, and Beartooth Mountains, (2) Bangtail, Bridger, and Crazy Mountains, (3) Pryor Mountains, (4) Ashland Unit, and (5) Sioux Unit.
- Twelve digit code hydrological units (HUC 12): The HUC12 watersheds that intersect the Custer Gallatin's proclaimed boundary will be assessed for conditions and trends from a watershed scale. These areas range from about 9,000 to 50,000 acres in size.

As already mentioned, most attributes are summarized by Montane and Pine Savanna units, capturing the ecological context of this groupings. However, some ecosystem components are described at the broader or more localized scales as appropriate.

The temporal scale of analysis varies. Current condition analyses typically depict data generally collected within the last 10 to 15 years. Conditions are reviewed in light of past activities and processes that have occurred as long as 140 years ago, at the time of settlement in the area. Assessments of trend include predictions up to 50 years from now.

Current Forest Plan Direction

The Custer (1986) and Gallatin (1987) forest plans have similar goals, objectives, and standards for managing aquatic ecosystems. Both forest plans defined riparian areas as "Areas with distinctive resource values and characteristics that are comprised of an aquatic ecosystem and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and all areas within a horizontal distance of approximately 100 feet from the normal high water line of a stream channel, or from the shoreline of a standing body of water." Forest Plan management areas M (Custer) and 7 (Gallatin) provide similar direction for management activities in riparian areas. The current forest plan goal for riparian areas is to provide healthy, self-perpetuating riparian plant communities with diverse understory and overstory vegetation. Riparian vegetation, including shrub and overstory tree cover, is to be managed along all perennial streams with defined channels to provide shade, to maintain streambank stability and in-stream cover, to promote filtering of overland flows, and provide valuable wildlife habitats. The same principle applies to shorelines of lakes and reservoirs. Uses and activities that could adversely impact these areas are to be mitigated. For example, in grazing allotments, adequate vegetation at the end of the growing season is recognized as important to provide streambank stability, protect streambanks from runoff events, and trap and filter potential sediment deposits. However, the utilization standards and other methods specified to meet these objectives are outdated in some cases because they don't reflect updated scientific knowledge or practical application.

Similarly, the goal of watershed management is to ensure soil and water resources are in desirable condition, water quality will be maintained at a level that meets or exceeds State water quality standards, and will remain so into the future. Soil, water quality, and fishery objectives are designed to assure that that these resources meet State water quality objectives and best management practices and that best management practices will be incorporated to assure management of resources will not have detrimental impacts to soil, water, and fishery resources. For example, structures built in streams (like bridges and culverts) will have minimal disturbance and be designed and installed for fish passage. Key wildlife and fisheries habitats will be managed and/or improved in coordination with partners and stakeholders when appropriate to maintain and enhance water quality, habitat quality and diversity, maintain species diversity, and to provide wildlife and fish-oriented recreational opportunities. Species-specific direction is given for indicators (such as cutthroat trout in cold-water and largemouth bass in warm-water aquatic habitats). However, some of these indicator species are no longer present on the Custer Gallatin (largemouth bass) because State fish management practices have changed, and indicator species direction in the plans no longer reflects current scientific canon. In addition, the presence of prairie fish species and their life history needs are not acknowledged, even though these species are present and have far different habitat and management considerations (Fausch and Bramblett 1991, Scheuer et al. 2003, Falke et al. 2011, Ficke et al. 2011, Dockery 2015) than salmonids for whom current direction is focused. Thus, watershed management direction needs to be updated to reflect current science.

Some differences exist between the two plans. For example, the Custer forest plan specifically speaks to maintaining adequate in-stream flows in all existing fisheries, managing livestock and human access routes to waterbodies will be managed to protect the aquatic resource, and closing areas, roads or trails as necessary to some or all motorized uses during specified periods, or indefinitely, to correct or prevent siltation problems that will degrade fish habitat. And the Gallatin forest plan gives special consideration to “Blue Ribbon” trout streams, the management of high mountain lakes, and efforts to develop mutually agreeable watershed management direction in watersheds with intermingled landownership. These kinds of differences, along with incorporation of new science and management strategies, need to be bridged in a new plan.

Existing Conditions

The Custer Gallatin is comprised of 329 12-digit HUC watersheds, of which 273 met the ownership criteria (at least 5 percent of the watershed is on National Forest System lands) and were therefore given Watershed Condition Framework ratings. At this scale, the framework summarizes indicators to give an overall assessment of watershed function: 226 watersheds rated as functioning properly and the remaining 47 watersheds (17 percent of all watersheds) rated as functioning at risk. Of the functioning at risk watersheds, 32 percent were on Pine Savanna units and 68 percent were on the Montane units. Specific stressors are discussed in detail by key ecosystem characteristics; the most consistent stressor on watershed condition across the Custer Gallatin was road and trail maintenance (247 HUC 12 watersheds, 91 percent of watersheds at functioning at risk or nonfunctioning for this rating element). In the absence of other stressors, road and trail maintenance did not alone determine watershed condition.

On the Montane units, in addition to road and trail maintenance, the three most consistent drivers of a reduction in watershed condition class were a reduction in native species (essentially, native trout are reduced to residual or isolated populations; 76 percent of watersheds are functioning at risk or not functioning); exotic/invasive species (broad presence of non-native trout, localized invasions of other species; 75 percent); and water quality issues (63 percent). Other stressors were watershed specific. For Pine Savanna units, modified flow characteristics (53 percent), aquatic habitat fragmentation (52 percent), modified stream channel shape and function (61 percent), reduced riparian vegetation condition (49 percent), and high open road density (68 percent) were consistent stressors on watershed condition. Life form presence (essentially, reduced aquatic biodiversity; 32 percent) and native species issues (31 percent) commonly combined with the other stressors to influence watershed condition.

PIBO monitoring data provide resolution as to how these watershed condition patterns manifest at reach scales (Archer and Ojala 2016a). The overall index of habitat condition (a composite of measured habitat values) for Montane stream reaches shows that managed watersheds (watersheds exposed to disturbance from various management actions) have habitat conditions about 15 percent lower than reference sites (relatively pristine watersheds that are used as a benchmark of expected condition). The distribution of biological integrity scores is skewed to a lesser extent, about 5 percent, with a similar range of biological integrity scores between managed and reference sites. Overall, about 60 percent of managed watersheds had a biological integrity similar to "pristine" conditions, whereas about 80 percent of reference watersheds met that criterion. Taken together, these patterns confirm that land management activities do imprint on Custer Gallatin aquatic habitat conditions, but also that disturbance is a natural occurrence (hence the range of habitat and biotic conditions at reference sites). Indeed, disturbance is often the agent that replenishes critical habitat elements, such as large woody debris and streambed substrates (Kreutweiser et al. 2012)). Specific habitat elements that are driving these differences will be discussed in detail in subsequent sections.

Composition

There are over 5,700 miles of rivers or streams (1:100,000 scale), and 801 lakes or ponds spanning more than 24,400 acres (1:24,000 scale) on the Custer Gallatin, with many more unmapped features (seeps, smaller ponds, small streams). Of mapped stream channel on the Custer Gallatin, 1,351 miles (24 percent) are considered ephemeral; about 57 percent of this amount is present on the Pine Savanna landscape, representing 63 percent of mapped channel on the Pine Savanna units. Conversely, ephemeral channels represent about 13 percent of Montane streams. A similar pattern holds for intermittent streams, as 33 percent of Pine Savanna streams, but less than 1 percent of Montane streams are intermittent. Four percent of Pine Savanna streams are perennial, as compared to 84 percent of Montane. Overall, more than 4,300 miles of intermittent and perennial stream are present on the Custer Gallatin, and expected to express riparian vegetation.

About 77,540 National Forest System acres of riparian areas[1] and corridors associated with these aquatic features comprise about 3 percent[2] of the Montane units and 1 percent of the Pine Savanna units (Table 2). Of that, nearly 30,000 acres contain riparian and wetland obligate vegetation types: riparian graminoid (grass and grass-like; about 19,700 acres), riparian deciduous tree (cottonwood, aspen, green ash; about 7,900 acres), and riparian shrub types (about 2,400 acres). The remaining 37,000-plus acres are dominated by nonriparian vegetation types, such as softwoods (Douglas-fir, Engelmann spruce) and dry grasses. This is likely a slight underrepresentation of Montane riparian vegetation as there are some data gaps in the central portion of the Madison, Gallatin, and Beartooth

[1] Includes the local classifications which refer to dominant vegetation type: Riparian-Graminoid, Riparian Cottonwood, Riparian-Aspen, Riparian-Green Ash, Riparian-Shrub, and Riparian-Corridor (riparian zone dominated by non-riparian vegetation – Douglas fir, lodgepole pine, Engelmann spruce, dry grass, and so forth)

Mountain Landscape Area. At long-term monitoring sites within grazing allotments, 484 plant species have been documented.

Table 2. Riparian vegetation dominance type and acreage by landscape area on Montane units of Custer Gallatin National Forest lands

Landscape Area	Aspen (%)	Cottonwood Green Ash[1] (%)	Graminoid[2] (%)	Shrub (%)	Total Acres Riparian Vegetation	Total Acres Riparian Corridor[3]	Grand Total Riparian (acres)	% of Landscape Area Riparian
Montane Units								
Bridger, Bangtail, Crazy Mtns	45	<1	38	17	2,036	3,429	5,465	3
Madison, Gallatin, Beartooth Mtns	20	1	72	7	25,466	42,229	67,695	3
Pryor Mtn	25	1	7	67	163	2115	2,278	3
Montane (%)	**22**	**1**	**69**	**8**	**27,665**	**47,772**	**75,438**	**3**
Pine Savanna Units								
Sioux	Trace[1]	59	36	5	1,259	NA	1,259	1
Ashland	Trace[1]	87	4	9	843	NA	843	<1
Pine Savanna (%)	**Trace**	**70**	**24**	**6**	**2,102**	**NA**	**2102**	**<1**
Grand Total	**NA[4]**	**NA**	**NA**	**NA**	**29,767**	**NA**	**77,540**	**3**

1. Aspen and cottonwood are present on the Pine Savanna units, usually within green ash dominant riparian, but are not the dominant species; green ash is only present on Pine Savanna units.
2. Moist site grass and grass-like vegetation (e.g. sedges).
3. Non-riparian vegetation dominates but riparian processes still at play (e.g. conifers dominate, but within recruitment zone of stream channel). Typical vegetation types: Douglas fir, Engelmann spruce, lodgepole pine, dry site grasses.
4. NA = not applicable

Thirty-six species of fish (21 native; Table 3) are known (or suspected, in some cases) to occupy approximately 2,880 miles of stream, and 565 lakes (includes lakes, ponds, reservoirs). Occupied stream is likely much higher because fish distribution hasn't been verified for many streams, particularly alpine and Pine Savanna streams. As fish distribution is verified, species composition is also likely to change, particularly in Pine Savanna and lower elevation Montane streams, where fewer surveys have been conducted, but where species diversity is higher. Across the Custer Gallatin aquatic macroinvertebrates occur in great abundance and diversity and are important indicators of bio-integrity. Currently there are 349 species of aquatic invertebrates known to occur on the Custer Gallatin. As inventories continue, that composition is also likely to change. Amphibians and reptiles are also present in waterbodies and riparian areas across the CGNF increasing the overall biodiversity. Amphibians are often associated with or even dependent on water and riparian areas while most reptiles, save for Snapping and Painted turtles, are not water/riparian obligates yet many are often present in and benefit from aquatic and riparian resources

Table 3. Fish species of the Custer Gallatin National Forest. Mileages indicated estimated occupied habitat on the Forest. An "incomplete survey" comment indicates distribution is likely more extensive than indicated, given knowledge of available habitat types.

Fish Species	Montane (miles)	Pine Savanna (miles)	Total (miles)	Status	Comments
Arctic grayling	28	0	28	SGCN - MT	Stream miles linked to occupied Montane lakes
Black bullhead	0	26	26	Introduced	Also in some Pine Savanna impoundments
Black crappie	0	0	0	Introduced	Pine Savanna impoundments
Brassy minnow	0	92	92	N	None
Brook stickleback	0	1	1	N	Incomplete survey
Brook trout	717	1	718	Introduced	None
Brown trout	384	0	384	Introduced	None
Creek chub	0	1	1	Native	Estimated based on adjacent records
Fathead minnow	0	63	63	Native	None
Flathead chub	0	8	8	Native	Estimated based on adjacent records
Golden shiner	0	0	0	Introduced	Pine Savanna impoundments
Golden trout	34	0	34	Introduced	Stream miles linked to occupied Montane lakes
Green sunfish	0	20	20	Introduced	Larger stream pools, impoundments; most widely distributed Pine Savanna invasive fish
Iowa darter	0	3	3	SGCN - MT	Incomplete survey; confirmed in both MT and SD
Lake chub	0	113	113	SGCN - SD	Confirmed in SD - Grand River tributary on Forest; also present downstream of Forest Boundary in several Montane HUCs
Lake trout	0	0	0	Introduced	Montane lakes
Largemouth bass	0	0	0	Introduced	Pine Savanna impoundments
Longnose dace	19	98	117	Native	None
Longnose sucker	66	0	66	Native	None
Mottled sculpin	419	0	419	Native	Also known as Rocky Mountain Sculpin
Mountain sucker	43	0	43	Native	None
Mountain whitefish	206	0	206	Native	None
Plains minnow	0	7	7	Native	None
Pumpkinseed	0	1	1	Introduced	Otter Creek
Rainbow trout	706	0	706	Introduced	Also stocked in Pine Savanna impoundments
River carpsucker	0	0	0	Native	Found at Boxelder Cr FS Road crossing

Fish Species	Montane (miles)	Pine Savanna (miles)	Total (miles)	Status	Comments
Sand shiner	0	1	1	Native	Estimated based on adjacent records
Sauger	0	0	0	SGCN - MT	Found at Boxelder Creek FS Road crossing
Shorthead redhorse	0	11	11	Native	None
Smallmouth bass	0	1	1	Introduced	Stocker Branch, Blacks Pond
Stonecat	0	8	8	Native	None
Utah chub	6	0	6	Introduced	Hebgen, Mystic Lakes
Westlope cutthroat	213	0	213	SGCN – MT	None
White sucker	87	560	646	Native	None
Yellow perch	0	0	0	Introduced	Pine Savanna ponds (e.g. Exie)
Yellowstone cutthroat	694	0	694	SGCN - MT	None

SGCN-MT= Species of greatest conservation need in Montana

Lotic aquatic ecosystems on the Custer Gallatin fall within 8 of Montana's 13 aquatic ecological systems (Table 4), representing all of the headwater and smaller mountain river aquatic ecological systems, except for those falling within the Northern Glaciated Plain Ecoregion and Medium Pine Savanna Rivers (Stagliano 2005). Very large river types (such as lower Yellowstone and Missouri Rivers) were also not present on the Custer Gallatin.

Montane aquatic ecological systems are most common on the Custer Gallatin, with Alpine Stream and Small Mountain Stream comprising over 79 percent of classified stream miles (Table 4). This represents about 11 percent of these aquatic ecological systems in Montana (MFWP 2015). Gradient of these streams is predominately greater than 2 percent (Stagliano 2005), resulting in stream channels in Rosgen A, B, and G types (Rosgen 1996). In general, these channels are also in the coarser substrate sizes that result in moderate to low sensitivities to disturbance (Barndt, personal observation). Localized reaches of low gradient, sensitive channel types (C4-5, E4-5) are present, particularly in meadows. In addition, higher gradient sensitive channels (A4-5, G4-6) are naturally present in some areas of the Montane units where finer grained, more erosive sediments underlie stream channels (such as Taylor Fork drainage). Larger Montane streams show similar patterns, although they are largely coarser grained B and C stream types. Over 400 miles of these channels are present on the Custer Gallatin (Table 4, Small Foothills, Intermountain Transitional Rivers).

Together these Montane aquatic ecological systems represent the Montana Tier I aquatic community type of greatest conservation need (CTGCN) for Mountain Streams (MFWP 2015). This community type was designated Tier I by Montana because its habitats are critical for conservation of Yellowstone trout (*Oncorhynchus clarki bouveri*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*), both species of greatest conservation need (MFWP 2015). These species are the only trout native to the Custer Gallatin, and are also found in Small Foothills Rivers (6 percent of Custer Gallatin lotic habitat, about 5 percent of Montana's total of this aquatic ecological system), and Transitional Rivers (4 percent Custer Gallatin, 12 percent of Montana's total).

Table 4. Custer Gallatin National Forest aquatic ecological systems, by ecosystem and landscape area

Ecosystem	Landscape Area[1]	Aquatic Ecological System	Miles	Comments
Montane	BBC, MGB, Pryors	Alpine Stream	2,567	MT CTGCN[2]
Montane	BBC, MGB, Pryors	Small Mountain Stream	899	MT CTGCN
Montane, Pine Savanna	Ashland, MGB, Sioux	Great Plains Intermittent Stream	400	MT CTGCN
Montane	BBC, MGB	Small Foothills River	260	MT CTGCN
Montane	BBC, MGB, Pryors	Intermountain Transitional River	183	MT CTGCN
Montane, Pine Savanna	Ashland, MGB, Sioux	Great Plains Pine Savanna Stream	55	MT CTGCN
Pine Savanna	Ashland, Sioux	Fishless Pine Savanna Spring	-n/a-	Point features; several highlighted as reference for this aquatic ecological system
Montane	BBC, MGB, Pryors	Spring Creek	-n/a	Incomplete mapping; e.g. Black Sand Spring
All	All	All	4,364	Total mileage; additional 1350+ miles of mapped, assumed dry channel

1. Landscape Area abbreviations: Bridgers, Bangtails, Crazies = BBC; Madisons, Gallatins, Beartooths = MGB.
2. MT CTGCN = Montana State Wildlife Action Plan 2015, Community Type of Greatest Conservation Need; South Dakota identified conservation opportunity areas, not ecosystems (South Dakota SWAP 2014) – no aquatic conservation opportunity areas included Custer Gallatin lands
3. Stagliano 2005

Within these habitats on the Custer Gallatin (all Tier I community types of greatest conservation need), westslope cutthroat trout occupy 88 miles and Yellowstone cutthroat 352 miles (GIS derived estimates from 1:100,000 NHD layer) (Table 5). Westslope cutthroat trout are native to all of western Montana and north Idaho, and the Missouri River drainage upstream of the Great Falls, whereas Yellowstone cutthroat are native to the Yellowstone River basin in Montana. Rangewide, westslope cutthroat are estimated to occupy 59 percent of historic habitats (approximately 15 percent considered not likely to be hybridized) while Yellowstone cutthroat occupy 43 percent (23 percent considered not likely to be hybridized) of historical stream habitat (Shepherd et al. 2005 Endicott et al. 2016).

On the Custer Gallatin, westslope and Yellowstone cutthroat trout historically likely occupied 949 and 758 stream miles, respectively. In the Missouri River basin, westslope cutthroat are far less common than their rangewide occupancy: the current Custer Gallatin westslope cutthroat distribution constitutes 9 percent of total habitat occupied by the subspecies in the Madison, Gallatin, and upper Missouri River watershed. The Custer Gallatin includes 34 percent of overall occupied cutthroat habitat in the major watersheds intersecting the national forest (Madison, Gallatin, Yellowstone).

The distribution of non-native salmonids is a primary reason for the reduced range of cutthroat trout: rainbow and brook trout are the most widely distributed salmonids on the Custer Gallatin, and these species, along with brown trout, may replace, displace, or hybridize native cutthroat (summarized in Table 3; Halfosky et al. 2016). As such, the Custer Gallatin and partners have built fish passage barriers to protect native trout from non-native trout. In conjunction with fish barrier construction or natural barrier enhancement, non-native trout are also removed chemically or physically from above the barrier site. Of the total mileage occupied by the cutthroat subspecies on the Custer Gallatin, about 73 miles of stream habitat has been secured for westslope cutthroat trout (83 percent of westslope cutthroat trout occupied stream miles) and 78 miles for Yellowstone cutthroat (22 percent of Yellowstone cutthroat miles) over the past decade. Cutthroat conservation will continue to be a priority for the Custer Gallatin, as Montana Fish, Wildlife and Parks has set the goal for cutthroat conservation at a minimum of 20 percent cutthroat occupancy in historically occupied watersheds (MFWP 2013).

Table 5. Cutthroat trout habitat occupancy on the Custer Gallatin National Forest

Custer Gallatin Habitat	Yellowstone Cutthroat Trout	Westslope Cutthroat Trout
Historic occupied stream habitat (miles)	758	949
Current occupied stream habitat (miles)	352	88
Historic habitat currently occupied by core/conservation populations (%)	46	9
Current populations in sympatry with Brook trout (%)[1]	28	0
Core/conservation habitat secured on Forest within last decade (miles)[2]	78	73

1. Sympatry with brook trout is a measure of competition risk
2. Secured means nonnatives removed, and precluded from reinvasion by a barrier

Table 6. Cutthroat trout habitat occupancy rangewide

Rangewide Habitat	Yellowstone Cutthroat Trout	Westslope Cutthroat Trout
Historic range-wide habitat currently occupied (%)	43	59
Populations occupying historic habitat considered not likely hybridized (%)[1]	23	15

1. Hybridization can compromise conservation value of populations

The Small Foothills and Transitional Rivers aquatic ecological systems within the upper Madison and Gallatin River drainages are habitat for an additional Montana species of greatest conservation need, western pearlshell mussel (*Margaritifera falcata*; Stagliano 2015). Western pearlshell mussel are uncommon on the Custer Gallatin, with viable populations present in only Duck Creek and the Madison River above Hebgen Reservoir (Stagliano 2015). This species occupies relatively low energy stream habitats with stable stream bottoms and gravel or smaller substrates, where native cutthroat are present; westslope cutthroat trout are a host of larval western pearlshell mussel (Stone et al. 2004). Because most Montane streams are high energy, with cobble and boulder substrates, western pearlshell mussel likely did not historically occur in the majority of Custer Gallatin Montane streams even if they were occupied by westslope cutthroat trout. However, the historical distribution of western pearlshell mussel was likely similar to westslope cutthroat trout range within Small Foothills and Transitional Rivers aquatic ecological systems because more stable, gravel bed stream reaches are more common. Therefore, western pearlshell mussel and westslope cutthroat trout declines in Small Foothill and Transitional Rivers aquatic ecological systems are likely interrelated (Stagliano 2015).

The majority of Custer Gallatin lentic habitats are associated with high elevation aquatic ecological systems as well, with 2,505 lakes and ponds above 6,500 feet elevation (Stagliano 2005). Many Custer Gallatin lakes (568) support fish populations, with 380 providing habitat for Yellowstone cutthroat, westslope cutthroat, and Arctic grayling (*Thymallus arcticus*), another species of greatest conservation need (MFWP 2015). Montana's Arctic grayling populations were recently reviewed by the U.S. Fish and Wildlife Service for possible listing as a threatened species; the resulting "not warranted" finding determined that the four Custer Gallatin Arctic grayling populations within the Gallatin River drainage were part of the species' distinct population segment (FWS 2014). All four of these populations (Hyalite Reservoir, Emerald Lake, Deer Lake, and Grayling Lake) are high elevation lakes where tributary streams provide additional habitat for Arctic grayling spawning and rearing (Table 3).

Many of these Montane lentic habitats, as well as some of the Montane lotic habitats provide breeding and rearing habitat for western toads (*Anaxyrus boreas*), another Montana species of greatest conservation need (Table 7). Western toads are relatively common in some portions of the Custer Gallatin, particularly Hebgen Lake and north in the Madison mountain range (Maxell et al. 2009). The Crazy Mountains and Beartooth Plateau are areas for which additional data are needed to assess species status; the species is considered vulnerable to population crashes, as has happened in other places within its distribution (Maxell et al. 2009). Hebgen Reservoir and adjacent littoral ponds provide breeding and rearing habitat for plains spadefoot (*Spea bombifrons*), a species of greatest conservation need more commonly found in Pine Savanna locales. Another amphibian species, northern leopard frog (*Lithobates pipiens*), is also a species of greatest conservation need. This species has not been documented on Montane portions of the Custer Gallatin since 1961, in East Rosebud Lake (MNHP 2016).

Table 7. Amphibian species of the Custer Gallatin National Forest

Species	Montane (presence)	Pine Savanna (presence)	Status	Comments
American bullfrog	no	no	introduced	Currently not on forest
Boreal chorus frog	yes	no	native	None
Columbia spotted frog	yes	no	native	None
Great plains toad	no	yes	native	None
Northern leopard frog	yes	yes	SGCN-MT	None
Plains spadefoot	yes	yes	SGCN-MT	None
Western tiger salamander	yes	yes	native	None
Western toad	yes	no	native	None
Woodhouse's toad	yes	yes	native	None

SGCN-MT = Species of greatest conservation need in Montana

Error! Not a valid bookmark self-reference. displays reptile species of the Custer Gallatin National Forest.

Table 8. Reptile species of the Custer Gallatin National Forest

Species	Montane (presence)	Pine Savanna (presence)	Status	Comments
Common gartersnake	yes	yes	native	None
Gophersnake	yes	yes	native	Mostly found in terrestrial habitat

Species	Montane (presence)	Pine Savanna (presence)	Status	Comments
North American racer	yes	yes	native	None
Plains garter snake	no	yes	native	None
Plains hog-nosed snake	no	yes	SGCN-MT	None
Painted turtle	yes	yes	native	None
Northern rubber boa	yes	no	native	Not an aquatic obligate, sometimes found in riparian areas
Snapping turtle	no	yes	SGCN-MT	None
Terrestrial gartersnake	yes	yes		None
Western milksnake	no	yes	SGCN-MT	Mostly found in terrestrial habitat

SGCN-MT = Species of greatest conservation need in Montana

Pine Savanna stream aquatic ecological systems (intermittent and perennial combined) comprise 10 percent of lotic habitat on the Custer Gallatin (1 percent of Montana's Pine Savanna stream total). Pine Savanna unit streams tend towards more sensitive channel types, for two reasons. First, stream channels are predominately less than 2 percent gradient (Stagliano 2005). Second, these steams largely flow through finer grained substrates, irrespective of channel gradient (Stagliano 2005, Archer and Ojala 2016b). Over 450 miles of these stream types are present on the Custer Gallatin (Table 4).

Both of these aquatic ecological systems are Montana Tier I community types of greatest conservation need (MFWP 2015), and at least one Montana species of greatest conservation need, Iowa darter, is present on the Custer Gallatin (3 populations, 2 in South Dakota and 1 in Montana; Table 3). Two additional species of greatest conservation need, sauger (in Montana) and sturgeon chub (both Montana and South Dakota; SDGFP 2014) are documented within Custer Gallatin watersheds, but downstream of the national forest boundary. Lake chub, a South Dakota species of greatest conservation need, is common on the Custer Gallatin in Montana, and is present in at least one location on the national forest in South Dakota, in the Grand River watershed. A notable feature of streams surveyed to date is non-native fish species are not common in headwater Pine Savanna streams, indicating that biological integrity is mostly intact by that measure (Table 3); Bramblett et al. 2005).

Based on indicator species presence, four prairie fish species guilds are present on, or influenced by the Custer Gallatin: darter, northern headwaters, madtom, and turbid river (Clingerman et al. 2013). The northern headwaters guild is by far most common, represented by presence of brassy minnow (confirmed in Tongue, Little Missouri, and Grand River tributaries on Forest), followed by small inclusions of the darter (confirmed in Little Missouri and Grand River tributaries) and madtom guilds (Table 3). Custer Gallatin tributaries provide spawning, rearing, and forage production resources for the turbid river guild (represented by sauger; Table 3), even though this guild is likely not present on Forest.

Lentic habitats on Custer Gallatin Pine Savanna landscapes are largely the result of constructed reservoirs (such as Mud Turtle and Rabbit Creek Reservoirs, Black's and Brown's Ponds), and these impoundments are the predominant source of many of the introduced fish species across this landscape, such as green sunfish, largemouth bass, and pumpkinseed (Table 3). These habitats, along with both fishless and fish bearing streams, are home to diverse macroinvertebrates and herpetofauna (refer to Table 3) (Stagliano 2010, MNHP 2016). Aquatic obligate species of greatest conservation need include snapping turtle (*Chelhydra serpentina*), plains spadefoot, northern leopard frog, and Great Plains toad (*Anaxyrus cognatus*). Of these species, northern leopard frog are commonly documented on Custer Gallatin, followed in order of commonality of occurrence by plains spadefoot, snapping turtle and great plains toad. The latter have only be documented eight times on the Custer Gallatin (MNHP 2016).

Aquatic invasive species, in addition to the fish species already discussed, are present in a few locations on the Custer Gallatin, and prevention of their spread as well as new introductions is an ongoing management concern (FWP 2016). Among species documented on the Custer Gallatin, the species of greatest concern are Curly-leaf pondweed (*Potamogeton crispus*), New Zealand mudsnails (*Potamopyrgus antipodarium*), and American bullfrog (*Lithobates catesbiana*) (MFWP 2016). The former species occupy Hebgen and Quake Lake, and New Zealand mudsnails are present in the Yellowstone River reaches near the Custer Gallatin. An additional species of concern, Eurasion watermilfoil (*Myriophyllum spicatum*), has been found downstream of the Forest. American bullfrog is present in the Stocker Branch above Blacks Pond; the species was apparently introduced into a private pond many years ago. Additionally, bullfrogs are present and spreading in the Yellowstone River system near Billings, Montana (Sepulveda et al. 2015) and as such could eventually reach national forest lands in other locations. Finally, the Yellowstone River has a new invasive species, *Tetracapsula bryosalmonae*, a myxosporean which can infect a variety of fish species and result in proliferative kidney disease. An outbreak in the Yellowstone River occurred in August 2016, killing thousands of fish.

Riparian areas are also susceptible to invasive plant species. Of the 75,438 acres of riparian vegetation found in the Montane units, 1,245 acres (2 percent) are infested with invasive plant species, typically with low densities. These are predominantly Canada thistle (*Cirsium arvense*). Of the 2,101 acres of riparian vegetation found in the Pine Savanna units, 268 acres or 13 percent are infested with invasive plant species. Canada thistle is the predominant invasive species. Salt cedar (*Tamarisk* spp.) has been found near the bounds of the Pine Savanna units. In the overall assessment area, approximately 5 percent of the riparian areas are infested with invasive plant species.

Within grazing allotment long-term monitoring sites, native species were most frequent and provided most cover, and invasive plants were rare. Invasive plants averaged 1 percent within the greenline transects. Canada thistle was found in 23 reaches, houndstongue was found in 10 reaches, oxeye daisy was found in one reach and tall buttercup was found in one reach along the greenline.

Although invasive plants are currently impacting a relatively low number of acres, the trend in infested acres is increasing (discussed in more detail in the Invasive Plants Report). Recovery patterns of riparian and other ecosystems have been less than desirable where exotic and invasive species are common. Invasion by aggressive exotic plants and animals is one of the greatest threats to all of the ecosystems in the Custer Gallatin, and may be become an even bigger challenge in a warming climate (Halofsky et al. 2016).

Beaver populations have likely declined across much of the assessment area due to trapping and reductions in woody forage species from livestock grazing impacts, road construction, and access-related activities (Pollock et al. 2015). Fire suppression is also a factor as riparian areas can convert from the cottonwood, aspen, green ash, and willow species preferred by beavers towards coniferous tree species under the prolonged absence of fire. This reduction in beaver populations in ecosystems adapted to their presence results in reduced and less resilient riparian and aquatic habitats (Bouwes et al. 2016). An estimated 50 percent of Pine Savanna stream miles have potentially suitable conditions to provide beaver habitat, whereas 30 percent of Montane streams have these ratings (Great West Engineering 2016). Although beaver are currently present in many of the stream reaches identified by the model as being highly suitable habitat, across the Custer Gallatin, occupied habitat is much less than the model projects. For example, on the Pine Savanna portion of the national forest, many of the stream reaches indicated as highly suitable have intermittent flow regimes, despite wetter than average conditions in the past five years, thereby violating the model assumption of reliable water supply (Efta and Layhee 2016). These reaches are roughly split between watersheds with fully functioning Watershed Condition Framework ratings and those with functioning at risk ratings), indicating that although land management activities such as grazing may play a role—particularly in modifying riparian vegetation—underlying landscape variables are likely driving observed patterns. Therefore, the model is a useful starting point, but additional analysis and ground-truthing is required to refine the model to understand where and how beaver might be managed to restore aquatic habitat composition. Nonetheless, beaver do appear to inhabit less of the landscape encompassed by the Custer Gallatin than they likely did historically (Pollock et al. 2015)

There are currently no federally listed threatened, endangered, proposed or candidate aquatic or invertebrate species on the Custer Gallatin. However, a stonefly species potentially found on the national forest is currently under review by the U.S. Fish and Wildlife Service. The Custer Gallatin has reviewed the current list of the Forest Service's Northern Region (R1) sensitive species and reviewed all other aquatic and invertebrate species that are known or could potentially occur on the Custer Gallatin. This has resulted in a list of identified potential species of conservation concern (Table 9). The Northern Region Regional Forester determines the final list of species of conservation concern. See the Appendix for more information and rationale for not identifying individual species as potential species of conservation concern.

Table 9. Potential aquatic and riparian species of conservation concern on the Custer Gallatin National Forest

Species Name	Conservation Ranking	Distribution in Plan Area	Rationale for identifying as Potential Species of Conservation Concern (SCC)
Western toad	G4S2 R1 Sensitive	Widespread but rare in Montane districts of Custer Gallatin.	Identified as SCC, on Custer Gallatin. Documented declines in abundance and use of suitable habitat since the 1990s (Maxell et al, 2009). This species has also had had range wide population declines including western Montana.
Arctic grayling	G5S1 R1 Sensitive	Documented on Custer Gallatin lands. Conservation work has occurred to increase habitat and populations.	Identified as SCC as the Missouri headwaters lake populations on the Custer Gallatin were recently (2014) designated by USFWS as part of the distinct population segment which, in part, led to this species not being listed under Endangered Species Act. These populations are critical to the conservation of the species in Montana.
Westslope cutthroat trout	G4T3 R1 Sensitive	Documented presence on Custer Gallatin and ongoing efforts to restore habitat and/or populations where feasible.	Identified significant rangewide population declines and current populations on Custer Gallatin being critical to conservation. Even though habitat trends are improving within the plan area, local populations could be succeptible to further hybridization, isolation, and declining numbers from stressors such as localized habitat degradation and climate change.

Species Name	Conservation Ranking	Distribution in Plan Area	Rationale for identifying as Potential Species of Conservation Concern (SCC)
Yellowstone cutthroat trout	G4T2 R1 Sensitive	Documented presence on Custer Gallatin and ongoing efforts to restore habitat and/or populations where feasible.	Identified as SCC because of significant rangewide population declines and current populations on Custer Gallatin being critical to conservation. Even though habitat trends are improving within the plan area, local populations could be susceptible to further hybridization, isolation, and declining numbers from stressors such as localized habitat degradation and climate change.
Gallatin mountainsnail	G5T1S1	Documented on Custer Gallatin.	Identified for SCC due to extremely limited endemic range on Custer Gallatin.
Western pearlshell	G4G5S2 R1 Sensitive	Documented on national forest lands.	Identified for SCC due to declining populations on national forest lands and rangewide.

Composition Summary

In summary, with the vast majority of 273 watersheds fully functioning (83 percent), no nonfunctioning watersheds, and most native aquatic species represented in its fauna, the Custer Gallatin is largely providing the aquatic ecosystem composition expected of its aquatic ecological systems. However, within some watersheds and stream reaches, some measures of composition depart from reference condition. The most prevalent changes to Montane aquatic ecosystems from expected composition are largely related to widespread introduction of non-native fish species, with replacement and displacement of native salmonids. Other elements of Montane aquatic ecosystem composition are largely intact, including habitat diversity, life form presence, and riparian vegetation. The PacFish/InFish Biological Opinion (PIBO) data quantify the first two elements; the range of habitat conditions were present on the Custer Gallatin as compared to both ecoregional and PIBO-wide reference conditions, and macroinvertebrate communities were the same in Custer Gallatin managed and reference watersheds, as well as ecoregional reference sites (Archer and Ojala 2016a).

In Pine Savanna aquatic ecosystems, departure from expected aquatic ecosystem composition is difficult to quantify because of the lack of habitat reference sites for many aquatic ecological systems. Aquatic habitat composition is generally well represented within and across the aquatic ecological systems, but legacy management impacts are more common than in Montane watersheds, reducing aquatic biodiversity (32 percent of watersheds) and life expression of native species (31 percent of watersheds). Riparian vegetation condition is functioning at risk in nearly half of Pine Savanna watersheds, and at 42 percent of stream reaches on which proper functioning condition surveys were conducted on livestock grazing allotments. Biotic indices at headwater springs aquatic ecological systems indicate that 67 percent are moderately or severely modified from reference sites, with impacts of cattle on riparian vegetation implicated as the likely cause (Stagliano 2010). These trends are not confined to national forest lands; an assessment of Great Plains aquatic conditions identified the portion of the Great Plains within which the Pine Savanna portion of the Custer Gallatin resides as the least impacted by broad-scale habitat modification; the aquatic ecological systems within the Custer Gallatin landscape were therefore priorities for conservation and restoration of prairie fish guilds (Clingerman et al. 2013). Within this context, some streams on the Custer Gallatin may represent some of the best examples of human-influenced fully functioning headwater Pine Savanna stream aquatic ecological systems with respect to composition, and opportunities for restoration (Stagliano 2010, Clingerman et al. 2013).

Structure

Channel shape and function and large woody debris were evaluated within the context of proper functioning condition, the Watershed Condition Framework, the PacFish/InFish Biological Opinion, and long-term monitoring within riparian areas. On the Montane units, 72 percent of proper functioning condition survey sites were found to be in proper functioning condition, with 25 percent functioning at risk and 3 percent rated as non-functional. The same overall pattern was evident in the Watershed Condition Framework watershed rating, where 19 percent of the watersheds' riparian vegetation condition component rated as functioning at risk, with the remainder rated as functioning properly. Long-term riparian monitoring data from Montane grazing allotments corroborate theses ratings—wetland prevalence index and hydric/mesic frequency and cover statistics indicate that most riparian monitoring sites within Montane grazing allotments have vegetation composition conducive for stable streambanks and other functions (the average wetland prevalence index value (2.72) indicates hydrophytic vegetation along the greenline overall). Five greenline surveys had index values greater than 3, indicating drier vegetation types and a possible departure from desired conditions. Within the greenline, relative frequency and cover of hydric species averaged 30 and 41 percent, respectively, mesic species averaged 37 and 29 percent, and upland species averaged 29 and 25 percent. Whereas they were localized issues in a relatively few watersheds on Montane districts, the Watershed Condition Framework rated over 60 percent of Pine Savanna watersheds as having persistent issues with channel shape and function and 49 percent had reduced riparian vegetation conditions (functioning at risk in all cases) as a result of both prevalent on-channel impoundments and impacts of cattle grazing. Long-term riparian monitoring data are not available for Pine Savanna grazing allotments for analysis of specific riparian attributes and trends.

For Montane districts, PacFish/InFish Biological Opinion (PIBO) data provide quantitative resolution at the reach scale and through repeated sampling, documented changes in habitat conditions. Four likely interrelated habitat elements had similar left-skewed distributions, indicating departure from reference conditions: large woody debris, pool frequency, residual pool depth, and bank angle (essentially, undercut banks; Archer and Ojala 2016a). These are likely related because large woody debris is the critical structural habitat element in forested Montane stream aquatic ecological systems that modulates stream energy, creating pools and conditions within which streambanks can be stabilized by vegetation (Rosgen 1996). Therefore, a lack of large woody debris can mean fewer, shallower pools and reduced undercut banks. The lack of large woody debris in managed watersheds is not surprising, because prior to the existing forest plans (1986, 1987), harvest of trees was not regulated in riparian and floodplain areas. Indeed, many of the trees in these locations were harvested prior to the creation of the National Forest System in the late 1800s and early 1900s (Barndt, unpublished data). Given the length of time for trees to grow to sufficient size to be considered large woody debris (larger than 10 inches diameter), then to be recruited to the stream through windthrow (roughly 150 to 200 years in Custer Gallatin National Forest ecosystems) insects, disease, and fire, Custer Gallatin streams are only now reaching a point at which recruitment of large woody debris is accelerating. This is also supported by PIBO data; a positive trend exists for large woody debris recruitment (Archer and Ojala 2016a). With the positive trend in large woody debris, the trend in residual pool depth is also likely to become positive.

The limited amount of data available from long-term monitoring within riparian areas of Montane grazing allotments indicates that age classes of trees and shrubs are skewed to younger classes: 55 percent are seedlings, 30 percent are sapling, and 16 percent are mature. This pattern indicates strong recruitment of the species driving this pattern: hardwoods (aspen and cottonwood) and shrubs (chokecherry and water birch). Because these species are important for wildlife, particularly beaver, the pattern may indicate habitat improvement at these sites.

Streambed substrates (both median particle size and fine sediments) are not different between managed and unmanaged Montane watersheds (Archer and Ojala 2016a). This is important, because fine sediments can limit the spawning and rearing success of coldwater trout, as well as the diversity of aquatic macroinvertebrates. It also indicates that any excessive sediment delivery to streams from historic management activities has stabilized within natural variability.

The limited PIBO data for Pine Savanna streams (n=5 to 8 sites, depending on the variable) indicate that stream habitat structure (bank stability, substrate size, pool frequency, residual pool depth) is stable, and that trend is stable or improving (Archer and Ojala 2016b). As noted previously, reference habitat conditions are lacking for these systems. For Montane streams, all structural habitat attributes are maintaining or improving, indicating a recovery from legacy management impacts (Archer and Ojala 2016a).

The Watershed Condition Framework ratings indicate that streambank attributes, evaluated as part of the larger category of stream channel shape and function, were localized issues for Montane streams. Conversely, about 60 percent of Pine Savanna watersheds were rated as functioning at risk for this attribute. Not all of this rating is a result of riparian conditions—some is a result of localized impacts of stock dams and water diversions on stream channels—but riparian conditions are the primary driver.

Data from PIBO indicate that, although the range of streambank conditions is similar between Montane managed and reference streams, there are more streams with reduced undercut banks in managed watersheds (Archer and Ojala 2016a). This overall pattern is a likely result of legacy land management and will be addressed in more detail in the "Large Woody Debris" discussion. For Pine Savanna units, the small number of PIBO sites and lack of reference sites limits inference, but streambank condition variables are stable at measured sites (Archer and Ojala 2016b).

Function

As noted previously, based on the Watershed Condition Framework, 63 percent of Montane watersheds had some kind of reduction in water quality. In most cases, this was related sediment delivery from road and trail infrastructure. However, it is also important to note that these water quality reductions are not pervasive enough in these watersheds that they led to a 303(d) listing or designation as "impaired" as defined by the Clean Water Act. The Custer Gallatin National Forest has 27 303(d) listed streams, all of which are largely beyond management control of the Custer Gallatin. The reasons these streams are listed on the Custer Gallatin are as follows: naturally high background levels of "toxic" elements such as arsenic; extensive water withdrawal for irrigation on downstream private lands; and development and other land uses occurring off national forest lands. Those effects that can be directly linked to Custer Gallatin management have been largely addressed. For example, in the Taylor Fork extensive road decommission and rerouting has nearly eliminated effects from roads, thereby addressing issues within Custer Gallatin purview, but this stream remains listed as the delisting process proceeds. Finally, over half of Pine Savanna watersheds have modified hydrology (such as impoundments on stream channels and water diversions for stockwater) whereas modified hydrology is less common in Montane systems.

In both Montane and Pine Savanna ecosystems, flow modification is largely related to impoundments and water diversion construction and operation. In some cases, such as Hebgen, Mystic and Hyalite Reservoirs, all Montane impoundments, these structures are relatively large in scope and scale. On the

Pine Savanna side, these tend to be smaller, designed for stockwater retention. In either case, habitat modifications are not always negative, even for native fauna. The increased lentic habitats correspondingly increases native amphibian breeding and rearing habitats (for example, Hebgen Lake is a key western toad breeding and rearing habitat; MNHP 2016), as well as lentic obligate macroinvertebrates (Stagliano 2010). On the other hand, these impoundments fragment lotic habitats (addressed elsewhere) and the changes they make to hydrology can impact life history expression of native lotic aquatic species. This is particularly an issue for the Pine Savanna watersheds, where the fauna are adapted to the intermittent and highly variable hydrologic cycle, and changes to this hydrology by multiple impoundments may result in impeding cues to migration, immigration, or other behaviors.

Dewatering is not a pervasive issue on either Montane or Pine Savanna landscapes, and therefore water quantity is not a limiting factor for most aquatic ecosystems on the Custer Gallatin. Commonly, major water diversions are located at or near the national forest boundary with private lands, and many Montane streams rapidly become dewatered immediately downstream of the Custer Gallatin boundary. As a result, lotic habitats on the Custer Gallatin serve as refugia and source populations for downstream reaches upon flow resumption. However, this pattern of dewatering also means that aquatic habitats on the Custer Gallatin are functionally fragmented from downstream mainstem habitats during much of the year. This pattern of dewatering is rare on Pine Savanna streams, because crop irrigation and concomitant water withdrawal are not common practices on the Custer Gallatin portion of the Pine Savanna landscape. However, there is localized dewatering of springs by stockwater development.

The potential for dewatering has led the Forest Service to proactively work to secure instream flow water rights. At present, the Custer Gallatin has over 60 instream flow water rights either secured or working their way through the application process, which has ensured that water will remain in over 300 miles of stream. Priority is given to those streams containing native cutthroat trout. Most of these water rights are on Montane streams because the unpredictable hydrology of Pine Savanna streams makes it challenging to capture the range of flows needed for the water right application process. Alternative approaches to those typically used in Montane systems are being explored to address this challenge.

Land management can influence flow regimes directly through water withdrawals and water storage or indirectly, through actions that result in loss of floodplain connectivity, groundwater recharge and the like. Direct impacts to flow regimes were estimated through the Watershed Condition Framework process: 30 Montane (16 percent) and 48 Pine Savanna (53 percent) watersheds were considered functioning at risk or had impaired function with respect to water quantity as a result of flow modifications by management actions.

The Custer Gallatin National Forest is a significant contributor of water locally and nationally (http://www.fs.fed.us/rmrs/projects/national-forest-contributions-streamflow). Locally, the national forest provides 66 percent of the discharge of the Shields River, 72 percent of the Stillwater River, and 75 percent of the Gallatin River. The Custer Gallatin supplies 5 percent of the flow of the Missouri River at its confluence with the Mississippi River, and 23 percent of the discharge of the Yellowstone at its confluence with the Missouri River.

The Custer Gallatin is also a source of groundwater whereby runoff, especially from snowmelt, on the national forest will infiltrate soils and stream substrates to recharge downstream aquifers. Montana's mountains may receive two to three times the amount of precipitation as nearby lowland areas. Currently there is not enough data to numerically differentiate these snowmelt recharge events from the Custer Gallatin versus deeper groundwater resources and which of those two has a larger impact on aquifers. However, hydrogeologic assessments (see: Marvin, 2000; English and Marvin 2000; Schemel, 2015) indicate that in close proximity to surface water some springs and wells may be under direct influence of surface water recharge driven by snowpack accumulation and precipitation. Groundwater recharge to shallow aquifer systems (hyporheic zones) has substantial importance to stream and river flow during base-flow, in some cases being critically important for surface water quantity, water quality, and/or thermal buffering for aquatic biota.

Across the Custer Gallatin, it is currently assumed (due to relatively sparse populations, large amount of wilderness and remote terrain, and lack of industry currently using that resource on the national forest) that groundwater extraction is not significantly drawing down aquifers. Monitoring in areas of high residential and commercial development and areas where industry needs to withdraw groundwater would determine the extent of potential impacts from those activities. There are very few natural sources of ground-water contamination. However, on the Custer Gallatin National Forest many streams and rivers of the Yellowstone, Gallatin, and Madison River systems drain from Yellowstone National Park where surface water flow from geothermal areas can naturally discharge compounds that are hazardous to humans and potentially fish and wildlife as well. For example, wells in the Madison River drainage have arsenic and fluoride concentrations that exceed U.S. EPA human health limits (Welch et al. 2000). Further, Schmechel (2015) found geothermal features within the south Hebgen basin confined aquifer are releasing arsenic and fluoride in quantities above the EPA human health standard.

Despite low-level effects to the groundwater resource at the forest plan level, there are some localized examples of effects on or near the Custer Gallatin. Adjacent to the Ashland District in the Powder River Basin there was a substantial increase in drilling and developing wells for coalbed methane production in the 2000s. This activity has dropped substantially, with 90 Montana wells producing methane and/or water in 2015 down from a peak of approximately 700 in 2008.Twenty-foot drawdown contours were found to extend a maximum of approximately 1.5 miles from the edge of producing coalbed methane fields, much less than the projected 4 miles. To date, monitoring data indicates that coalbed methane production has not affected groundwater table depth or groundwater quality on the southern end of the Ashland District (Kuzara et al. 2016; also previous Montana Bureau of Mines and Geologycoalbed methane monitoring reports). If this development activity, likely coinciding with changes in natural gas economy and industry, were to again increase and wells were being pumped on or adjacent to national forest lands, groundwater resources may be impacted. Coalbed methane development requires withdrawing large volumes of groundwater to release the methane gas. Myers (2009) found that drawdown of groundwater from coalbed methane fields could exceed 6 meters in depth and extend many kilometers beyond the well or gas field affecting groundwater resources, wells, springs, and pumps. Additionally, replenishing of groundwater resources could take on the order of up to 50 years depending on various parameters such as geologic porosity, and other factors.

The Stillwater Mining Company's extensive palladium and platinum mine operations in the East Boulder and Main Stillwater drainages have rerouted groundwater pathways and altered groundwater quality and quantity. Montana Department of Environmental Quality and the Custer Gallatin National Forest cooperatively regulate and manage water resource impacts associated with mine infrastructure, and as such surface water quality is maintained within State water quality standards. While much of the mine infrastructure is on private land adjacent to national forest lands, the ongoing Benbow Exploration Portal development is on national forest lands. Water from this development will be rerouted to the mine for treatment. Over approximately a five-year time span, produced water will be treated then injected into the regional Madison aquifer.

The Sioux Ranger District has three oil and gas wells, two in the North Cave Hills and one in the South Cave Hills. One of the two wells in the North Cave Hills is a saltwater disposal well. No local surface water or groundwater effects have been observed (K. Hansen, District Ranger, Sioux Ranger District, and P. Pierson, Custer Gallatin Forest Geologist, personal communication).

Through a combination of both natural occurrence and past mining activity, both surface water and groundwater in the Emigrant Creek drainage (Yellowstone Ranger District) have been affected by iron precipitates yielding ferricrete deposits. While macroinvertebrates have not been surveyed in Emigrant Creek, 2015 monitoring did not find any fish in Emigrant. This monitoring, in tandem with past water quality sampling and 2015 sampling, suggests that water quality is compromised enough to preclude supporting viable aquatic communities in Emigrant Creek (Hargrave et al. 2000).

Connectivity

Natural barriers to longitudinal connectivity, such as waterfalls, have not been fully cataloged across the Custer Gallatin. However, fish were likely historically absent in most alpine streams and lakes, as natural barriers to upstream fish migration commonly exist in most watersheds at roughly 7,000 feet elevation. Lateral connectivity naturally varies by stream type, and is inherently included in the aquatic ecological systems. Human-created barriers to both kinds of connectivity can modify floodplain function and services, species diversity, life history expression, habitat use, and gene flow, and ultimately, species viability (Fagan 2002, Opperman et al. 2010). However, in some cases, restoring connectivity may facilitate invasions of non-native species to the detriment of native species (particularly native trout), requiring a careful analysis of tradeoff of isolation and connectivity of populations (Fausch et al. 2009)

Human-created barriers to longitudinal connectivity (primarily road crossings) have been surveyed for most of the Montane landscape (GNF 2006), and surveys are ongoing across the remaining Montane and Pine Savanna watersheds. Of 277 stream-crossings surveyed to date (249 Montane, 28 Pine Savanna), 254 were deemed to impact hydrologic (and thus riparian) processes. As a result, 49 structures have been removed or modified to restore hydrologic function on over 200 miles of stream corridor. Of these, 46 structures were modified to provide organism passage (45 Montane, 1 Pine Savanna; with more than 200 miles of habitat opened), whereas three were modified to remain barriers to fish passage but still restore hydrologic function. As noted previously, connectivity is not always desirable when non-native trout are present; an additional 14 barriers, securing more than 80 miles of habitat, have been built to isolate native cutthroat populations where the risk of invasion outweighed the risk of isolation (Fausch et al. 2009). With respect to the Watershed Condition Framework, 32 Montane (12 percent) and 42 Pine Savanna (52 percent) watersheds were considered functioning at risk as a result of fragmentation by dams of all sizes.

Human influence on lateral connectivity was assessed as part of the Watershed Condition Framework analysis. Road proximity to streams was deemed a hydrologic issue (more than 10 percent of roads in the watershed is within 300 feet of streams) in 49 of 192 (26 percent) of Montane watersheds, whereas it was not deemed an issue in any of the Pine Savanna watersheds. This is a legacy effect of how roads were often built in the past in narrow Montane valleys, essentially next to the stream channel.

Key Benefits to People

Aquatic and riparian ecosystems on the Custer Gallatin support a wide variety of direct human uses and benefits, although many of these uses may impair ecosystem function if not properly managed (Poff et al. 2012). Among these are angling and other forms of recreation, municipal and residential water supply, and agricultural uses (stock water, irrigation). In addition, these ecosystems provide a variety of additional benefits, such as flow modulation (buffering both flood and baseflows), water filtration, erosion control, groundwater recharge, wildlife habitat and migration corridors, and scenery.

As of 2009, angling on just the five most-fished Custer Gallatin waterbodies (Madison, Gallatin, and Yellowstone Rivers; Hebgen and Hyalite Reservoirs) was over 146,000 angler days, with 45 percent of these angler days representing nonresident fishermen (MFISH 2016). These numbers don't account for the secondary benefits of high quality water, forage, and fish produced on the Custer Gallatin that support mainstem fishing on segments of those streams and others downstream of the national forest boundary. The portion of Madison River downstream of the Custer Gallatin alone supports nearly 121,000 angler days a year, whereas the Yellowstone has over 71,000 angler days.

In addition to these nationally and internationally known fisheries, the Custer Gallatin supports diverse locally and regionally important angling opportunities. Among these are high mountain lakes, where species like golden and lake trout, and Arctic grayling are destination fisheries for some anglers, and Pine Savanna reservoirs, where largemouth and smallmouth bass, panfish, and put-and-take rainbow trout are targeted species. Overall, National Visitor Use Monitoring data show that 4.9 percent of Custer Gallatin visitors came to the national forest for the primary purpose of fishing, whereas 8.2 percent of all visitors annually fished (254,000 of the Custer Gallatin's annual visitation of about 3.1 million people). Impacts to fisheries from angling, and the practice of fish stocking, is under the management of State fish and game agencies.

The Custer Gallatin directly provides municipal water supply to the cities of Red Lodge, West Yellowstone, and Bozeman. Indirectly, streams emanating from the national forest assist in supplying water to cities like Billings and Laurel, and are the groundwater recharge zone for residential supplies in many places. For example, although difficult to quantify groundwater recharge for the Bridger Mountain foothill housing developments near Bozeman is likely enhanced by groundwater inflow from the adjacent Bridger range (Hay 1997). In addition, 5,410 private water rights (Table 10) are held on points of diversion on the Custer Gallatin; some of these are for residential use, and others are for agricultural purposes.

Table 10. Water rights held on the Custer Gallatin National Forest

Water Rights	Total	Domestic Use	Irrigation	Commercial	Lawn & Garden	Geothermal	Fish & Wildlife
Number of water rights	5,410	2,058	1183	250	511	4	194

A less commonly considered benefit of national forest watersheds is flow modulation—essentially, moderating both high and low flows through the function of floodplains and wetlands. Water storage and retention in national forest floodplains can both reduce the rate and duration of peak flow response, but also assist in retaining base flows. These processes can be amplified by beaver colonies; although beaver may become a management challenge in some cases on private lands (blocking culverts or flooding private property), these are not typically issues on the Custer Gallatin.

More than half of Montanans depend on groundwater for their primary water supply. However, that current withdrawal represents a small percent of the available groundwater recognizing that the amount of available groundwater far exceeds that of available surface water. According to the Natural Resource Information Service, groundwater provides 94 percent of Montana's rural domestic water supply and 39 percent of the public water supply. Montana uses over 188 million gallons of groundwater per day for domestic use, public water supplies, irrigation, livestock and industry (USGS, Estimated Use of Water in the United States in 2000). Water generated in the mountains and hills of the Custer Gallatin is an important source of recharge for valley aquifers and is therefore an important ecosystem service provided by the national forest. Demand for water will likely increase in importance with an increasing population, increasing demand for aquatic and riparian resources, and potential effects of climate change on these resources (Poff et al. 2012).

Trends and Drivers

Most drivers of aquatic ecosystems have been discussed in the context of existing condition, the Watershed Condition Framework, and aquatic and riparian ecosystem characteristics, and their interactions. Those already covered are not repeated here, but their trends will be discussed.

Climate

Climate has been warming for the Montane portion of the Custer Gallatin, and that trend is expected to continue in the future (Halofsky et al. 2016). In general, the Montane portions of the Custer Gallatin are projected to be a relatively cooler habitat island (Halofsky et al. 2016). Therefore, perennial stream reaches in higher elevation areas that have fully functioning habitats and groundwater entry will be most resilient to warming conditions and changing weather patterns. Conversely, lower elevation stream reaches with less than fully functioning habitats and losing flows to groundwater will be the least resilient reaches to changing conditions. However, changing precipitation patterns, along with warming temperatures are predicted for most of the Custer Gallatin, which may change flow regimes (timing, duration) and disturbance patterns (floods, drought, fire; Halofsky et al. 2016). Thus, it is likely that plant phenology, community structure, and successional patterns will be impacted, with possible changes to aquatic habitat structure as a result. The potential climate change impacts to vegetation are discussed in more detail in the Vegetation report.

Impacts of projected warming have been modeled on the Montane portions of the Custer Gallatin, with respect to how stream temperatures may be impacted (Halofsky et al. 2016). This model indicates that more than 99 percent of currently occupied Custer Gallatin cutthroat habitat is likely to remain thermally suitable for the foreseeable future. However, the suitability of the habitat may be compromised if non-native brook trout are present (Halofsky et al. 2016), which is true for some of the Yellowstone cutthroat trout habitats (Table 3). The model also shows that streams at lower elevation, currently suitable for coldwater salmonids, are likely to become marginal, particularly for cutthroat trout (Halofsky et al. 2016), although local thermal refugia can remain even within these reaches (Dugdale et al. 2013). As such, these streams may become suitable for a broader species assemblage for which these habitats are currently too cold (such as native suckers and minnows). Conversely, many higher elevation habitats likely to remain thermally favorable for coldwater salmonids (including native species) are not currently occupied. Because natural and man-made barriers may preclude migration to these habitats, assisted migration or barrier modification may be required for these to provide refugia in the future (Halofsky et al. 2016). Arctic grayling already occupy Montane lakes presumed to be less vulnerable to climate change, although inlet and outlet streams may be impacted by warming and reduced streamflows (Halofsky et al. 2016). Monitoring will be required to validate these changes and to understand impacts to Arctic grayling populations.

Changes to stream temperature aren’t the only potential impact of a warmer climate; precipitation regimes are also projected to change, with more extreme events and earlier snowmelt (Halofsky et al. 2016). Thus, the Custer Gallatin is also conducting an analysis to determine which Montane watersheds are likely to be most reactive to climate change, based on the interaction of terrain and underlying geology. The results will portray watersheds likely to be more or less responsive to climate change. Results will be added when they are available.

Combined, the two modeling efforts indicate that Montane portions of the Custer Gallatin provide potential refugia for coldwater salmonids and an opportunity for expanding range of cool water species for which habitats are currently too cold. The results also highlight watersheds for which restoration actions can be prioritized (such as habitat fragmentation, habitat restoration, instream flow procurement) as appropriate.

Impacts of climate change on Pine Savanna aquatic systems are less predictable, in part because less is known about flow regimes and species distribution, and in part because these systems are already dynamic. Thus, these habitats, and the species occupying them, are adapted to highly variable intra- and interannual temperature and flow conditions. However, the general pattern expected for this landscape is warmer temperatures and neutral to slightly increased precipitation; the net result is expected to be less water available in summer months (SDGFP 2014). As with Montane habitats, more extreme and variable weather is anticipated in the future (Halofsky et al. 2016). Of the four aquatic species guilds present on these landscapes, the northern headwaters guild may be most susceptible to changing temperatures, whereas all four guilds are likely sensitive to amount and timing of flows (Halofsky et al. 2016). Lake chub, a South Dakota species of greatest conservation need in the northern headwaters guild, is considered extremely vulnerable to climate change in South Dakota (SDGFP 2014).

Because the impacts of climate change to ecosystems are not likely to be linear or easily predictable anywhere, it is still possible that ecosystems will look different even in watersheds that exhibit relatively less change in water temperature and flow regime, and likely they will look quite different in watersheds where changes are more likely (Williams and Jackson 2007, Grenouillet and Comte 2014). Novel approaches, including active management of stream temperatures through groundwater inputs, have been suggested as ways of maintaining some species and assemblages (Kurylyk et al. 2014), as well as designating larger species or ecosystem refugia to accommodate more variable conditions (Verboom et al. 2010). In any case, a prudent general strategy is to conduct management actions that buffer variations in flow regimes, protect and restore riparian vegetation and processes, and reduce habitat fragmentation; the strategy can be refined as more local information is derived (SDGFP 2014, Williams et al. 2015, Halofsky et al. 2016).

Fire

Fire in and near riparian areas is an important disturbance element driving ecosystem processes, such as large woody debris recruitment to stream channels, reducing conifer encroachment, and increasing deciduous vegetation; all of which can enhance filtering and flow modulation roles of riparian areas and provide the basis for beaver colonization, among other benefits (Bisson et al. 2003). Riparian areas frequently differ from adjacent uplands in attributes influencing fire regime: vegetative composition and structure, geomorphology, hydrology, microclimate, and fuel characteristics. Although these features, combined with land management, may contribute to different fire environments, regimes, and properties (frequency, severity, behavior, and extent), fire remains a critical driver of ecological processes in riparian areas (Bisson et al. 2003). Some riparian plant species, such as aspen, cottonwood, green ash, chokecherry, or coyote willow possess natural defense mechanisms to some stressors, having the ability to sprout after fire or flood (Hansen et al. 1985). These adaptations to disturbances facilitate survival and reestablishment following fires, thus contributing to the rapid recovery of many streamside and seep habitats. Both fire regime and impacts of fire are assessed as part of the Watershed Condition Framework; only 29 percent of Montane and 27 percent of Pine Savanna watersheds are within their natural fire regime or within fully functioning condition, if recently burned. One watershed across the Custer Gallatin was rated as impaired function, with the vast majority of the watersheds rated as functioning at risk with respect to fire regime.

Livestock Grazing

Currently, about 22 percent of the Custer Gallatin National Forest is primary rangeland used by permitted livestock. About 13 percent of riparian vegetation in the overall assessment area are within primary rangelands (about 3,900 acres). About 5 percent of riparian vegetation found in the Montane units are within primary rangelands (about 2,100 acres). About 86 percent of riparian vegetation found in the Pine Savanna units are within primary rangelands (about 1,800 acres). Elmore and Beschta (1987) suggest that although many factors can result in adverse changes to riparian areas, livestock grazing is unquestionably a significant factor. Within the Montane primary rangeland, 72 percent of riparian survey sites were found to be in proper functioning condition, with 25 percent functioning at risk and 3 percent were rated as nonfunctional. Within the Pine Savanna primary rangeland, 58 percent of the survey sites were found to be in proper functioning condition, with 42 percent functioning at risk and none rated as nonfunctional. Since grazing is intrinsically associated with potential challenges, its management is also fundamentally important to solutions.

The overall livestock use levels continues to decrease from historical use. As an example, a summary of historic grazing records for the Pryor Mountains indicate that current forage off-take by permitted livestock is about 14 percent of the use that was occurring in the early 1900s (see permitted grazing report for details). During the 1940s to 1960s stocking rates were reduced, seasons of use were shortened, and cross-fencing for pasture rotation and increased opportunity for rangeland recovery occurred. Adjustments in stocking rates, use levels, season of use, and duration of use have continued.

Current prescribed stocking rates, use levels, season of use, and duration of use are well below 1986 Custer and Gallatin Forest Plan levels. Since the 1986 forest plan timeframe, permitted use (animal unit months) on the Custer Gallatin have decreased 23 percent (42 percent on the Gallatin, 19 percent on the Custer). The changes in Gallatin units were primarily due to allotment closures of long-standing vacant allotments, whereas the changes in the Custer units were primarily made to respond to carrying capacity/stocking rates and range readiness issues. Based on monitoring, more recent stocking rate reductions have been implemented on several allotments, typically ranging from 10-30 percent and as high as 50 percent. Although these changes have likely improved riparian conditions in many places, improvement practices and monitoring in riparian continues to be needed. Rates at which riparian areas recover after adjustment of livestock management or removal are site dependent (Meehan et al. 2016) and can be quite rapid particularly for riparian vegetation (Hansen and Budy 2011, Hough-Snee et al. 2013) or prolonged, as is the case for degraded stream channels in some Pine Savanna systems (Meehan et al. 2016).

Trend

PacFish/InFish Biological Opinion (PIBO) and fish distribution data demonstrate that Montane aquatic habitat and biota trends are stable or improving (Archer and Ojala 2016a). As noted previously, trends in habitat improvement are likely tied to the combination of improved management sideboards, restoration actions (road decommissioning, notably), and natural replenishment of large woody debris. Native species have been replaced or displaced in many streams by non-native species; however, interagency conservation planning and restoration is stabilizing this trend, and reversing it in some key locations on the Montane landscape. To date, a combination of population replication, genetic swamping and non-native fish removal has secured native cutthroat trout in more than 225 miles of stream and 150 lake acres on and adjacent to the Custer Gallatin National Forest.

PIBO data are limited for the Pine Savanna portion of the Custer Gallatin, but for the handful of sites for which it currently exists, the trend is stable for habitat variables (Archer and Ojala 2016b). Watershed and aquatic restoration is in its infancy across this landscape, as habitat condition and fish distribution are still being quantified. However, the riparian and biotic data that exist demonstrate that a pressing priority is restoring aquatic diversity in conjunction with perennial spring ecosystems (Stagliano 2010), and in riparian areas overall. Much of the reduction in aquatic diversity is a result of livestock presence, water diversion and impoundments at, and near, headwater springs.

The Watershed Condition Framework ratings are semi-quantitative (some elements are quantitative, others subjective); even so, results through two rating periods indicate that trend is stable overall, with improvements related to watershed restoration actions, and declines related to broad scale disturbance from wildfires. The Watershed Condition Framework results are used for more than just information; they are intended to form the basis for identifying watershed restoration priorities. As such, the Custer Gallatin, along with its partners, has developed watershed restoration action plans for watersheds on both Montane and Pine Savanna watersheds. These plans provide detailed analysis and timelines of restoration actions required to improve or stabilize watershed condition. To date, watershed restoration action plans have been completely implemented on two watersheds (one Montane, one Pine Savanna), with restoration actions in progress from three additional Montane and one Pine Savanna watershed restoration action plans. Typically, restoration actions contained within these plans take several years to plan and implement, because of budget and workforce capacity constraints. All watershed restoration action plans, past and present, have included road maintenance or decommissioning actions (not surprising, given the pervasive nature of that stressor in watershed across the Custer Gallatin) along with other watershed-specific restoration actions.

Information Needs

The information needs identified in this section are those that will provide for more effective management of the Custer Gallatin under a new plan. They are not necessary for revising the existing plan.

Montane Watersheds

Fish and macroinvertebrate distribution and habitat capability mapping is needed to guide continued restoration of native salmonids and other species. Trends in stream temperatures, habitat conditions, glacier conditions, species assemblages and other variables are critical to understanding if our assumptions regarding the impacts and ecosystem responses to climate change are accurate, and to guiding management strategies. Reference condition information is needed for riparian vegetation to give context to data collected within range allotments, to help guide management decisions. Wetland mapping is near complete, although the Beartooth plateau still lacks detailed mapping from the Montana Natural Heritage Program.

Pine Savanna Watersheds

Reference condition information is needed for the Pine Savanna stream ecosystems, both instream habitat and near-channel habitats (riparian, floodplain), so that realistic expectations for habitat management and restoration can be understood. The Forest Service is currently working with the Natural Resource Conservation Service to prepare ecological site descriptions that describe expected riparian vegetation and soil conditions with the Custer Gallatin Pine Savanna watersheds. These ecological site descriptions remain provisional and primarily cover deciduous riparian vegetation habitat. The Custer Gallatin continues to characterize flow regime, both spatially and temporally, since flow periodicity is critical to understand sideboards to management Pine Savanna in addition to restoration opportunities where suitable habitat exists to reintroduce beaver. Stream temperature monitoring, macroinvertebrate monitoring at headwater springs, and fish population monitoring across spatial and temporal scales are needed to help inform and guide management actions. Quantitative trend data for a broader suite aquatic habitat variables is also needed.

Forestwide

More information is needed on groundwater resources, particularly as it may moderate impacts to or be impacted by climate change. Refined beaver habitat mapping using flow and riparian information is also needed to inform restoration opportunities. Refinement of climate models and resource vulnerability, along with ground-truthing of the same, is needed to direct and prioritize restoration efforts.

Key Findings

The Custer Gallatin falls within three different ecoregions with differing geology, altitude, climate patterns, sediment dynamics, and flow regimes, which makes for aquatic ecosystems that have highly variable ecology across this national forest unit. As such, aquatic or semi-aquatic species diversity is relatively high on the Custer Gallatin with 36 fish species, 7 amphibian species, 10 reptile species, at least 349 aquatic invertebrate species and more than 430 riparian plant species.

Although relatively rare (about 3 percent of the Montane units and 1 percent of the Pine Savanna units) riparian areas are among the most critical elements of biodiversity and wildlife habitat, as well providing key ecosystem services such as water filtration, streambank stabilization, and groundwater recharge. These habitats are widely distributed across the Custer Gallatin, in association with about 3,341 lakes and ponds and many more unmapped lentic features (seeps, smaller ponds), and with more than 4,300 miles of intermittent or perennial stream channel likely to express development of riparian vegetation.

Watershed Condition Framework ratings indicate the majority of our watersheds are functioning properly, and therefore are generally not currently a restoration priority. Overall, about 60 percent of managed watersheds had a biological integrity similar to pristine conditions, whereas about 80 percent of reference watersheds met that criterion. However, there are a suite of threats to aquatic systems such as climate change, invading and hybridizing exotic plant and animal species, and legacy land-use issues (e.g. recovery from land-uses prior to the establishment of or land acquisitions into the national forest, legacy forest management) that will continue to be a challenge for land managers. As such, even watersheds currently functioning properly may require restoration actions to maintain proper function.

Livestock grazing can have a primary influence on the condition of riparian areas. Within the Montane units, where 8 percent of riparian areas are within primary rangelands permitted for grazing, 72 percent of the riparian survey sites were found to be in proper functioning condition, with 25 percent functioning at risk, 3 percent rated as non-functional, and long-term monitoring within grazing allotments indicates vegetation conditions support resilient riparian areas. However, on the Pine Savanna units where 86 percent of riparian areas are within primary rangelands, 58 percent of riparian survey sites were fully functioning, and about 42 percent were rated as functioning at risk for riparian conditions. At the watershed condition framework scale, 49 percent of Pine Savanna watersheds were rated as functioning at risk for riparian conditions. About 60 percent of Pine Savanna watersheds were rated as functioning at risk by related impacts of cattle grazing, such as on-channel water impoundments for stock watering and streambank modification. Biotic indices at headwater Pine Savanna springs indicate that 67 percent are moderately or severely modified from reference sites, with impacts of cattle on riparian vegetation implicated as the likely cause.

Connectivity along riparian corridors is related to longitudinal stream hydrologic connectivity because riparian zone development and function are linked to stream flow characteristics interacting with terrestrial environment. Of 277 stream crossings surveyed to date (249 Montane, 28 Pine Savanna), 254 were deemed to impact hydrologic and thus riparian processes. As a result, 49 structures have been removed or modified to restore hydrologic function on over 200 miles of stream corridor.

A baseline understanding of groundwater and the Custer Gallatin contribution to local aquifers and groundwater will help to understand impacts from climate change and development.

Beaver populations have likely declined across the Custer Gallatin, although methods to predict the extent of their suitable habitat need refinement. Restoration of beaver populations and activities, where appropriate, can create more resilient aquatic systems to factors that add stress to aquatic systems, such as climate change.

Despite the various management challenges, Custer Gallatin National Forest lands are considered as critical for aquatic conservation by partner agencies and the public. For example, westslope and Yellowstone cutthroat trout conservation has had success in the Gallatin, Madison, Yellowstone, and Shields River systems in large part due to the availability of quality habitat on the Custer Gallatin. Arctic Grayling was recently (2014) confirmed by the U.S. Fish and Wildlife Service as not warranted for listing under the Endangered Species Act in part due to stable habitat and populations on the Custer Gallatin. Recent strategic planning for prairie fish conservation and headwater Pine Savanna springs indicates that Pine Savanna stream ecosystems on the Ashland and Sioux districts may be regionally important for aquatic conservation.

The Custer Gallatin Montane areas are a highly popular angling and recreation destination both for Montanans and nationally, even internationally being that it is adjacent to Yellowstone National Park. Angler days are and will likely increase across the Custer Gallatin with several blue ribbon trout fisheries available (not to mention hundreds of miles of smaller streams and thousands of acres of lakes). Other recreation opportunities that could affect aquatic ecosystems, such as whitewater kayaking, are also increasing on the Custer Gallatin.

Both plans currently work. However, their use is inefficient, given the progression of science and management, and Forest consolidation. An updated and combined plan incorporating new science should be more effective.

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Appendix: Species Evaluated and Not Identified as a Potential Aquatic Species of Conservation Concern

The following species were evaluated, but not identified as potential aquatic species of conservation concern (SCC).

Species Name	Conservation Ranking	Distribution in Plan Area	Rationale for evaluating and not identifying as Potential Species of Conservation Concern
Plains Spadefoot	G5S3 R1 Sensitive	On Custer Gallatin lands; locally abundant, overall abundance unknown.	Not identified as SCC because of state S3 ranking, lack of data as to it abundance and population status in Montana, and broad range. Continued inventory will determine abundance on Custer Gallatin and thus the importance of Custer Gallatin populations to conservation of this species that could potentially lead to SCC status in the future.
Great Plains Toad	G5S2 R1 Sensitive	On CG lands but rare.	Not identified as SCC due to being relatively common and populations globally are stable.
Northern Leopard Frog	G5S1S4 R1 Sensitive	Common on the Ashland and Sioux districts. Populations have declined in the montane districts.	Not identified as SCC because while threats such as grazing and chytrid fungus could harm individuals, studies by Montana Natural Heritage Program have not linked the fungus to actual declines. Strongholds occur on Custer portion of forest. Species likely not present at higher elevations on Gallatin portion of Forest.
Blue Sucker	G3G4S2S3	Has not been documented on Custer Gallatin.	Not identified for SCC as Custer Gallatin lands do not provide habitat for this species.
Finescale Dace	G5 SE/S1 for South Dakota	Has not been documented on Custer Gallatin.	Not identified as SCC as not documented on national forest and likely was not historically present.
Iowa Darter	G5S3	Recently (2016) documented on the Sioux district in both MT and SD.	Not identified as SCC because of its range-wide stability and state rank of S3. Custer Gallatin streams likely serve as a stronghold for this species persistence in the region. Continued inventory will determine abundance on Custer Gallatin and thus the importance of Custer Gallatin populations to conservation of this species that could potentially lead to SCC status in the future.
Lake Chub	G5 SH for SD	Documented on Custer Gallatin on the Sioux district.	Not identified for SCC due to being relatively common in Montana, documented in South and North Dakota and currently on South Dakota list of rare animals but not state threatened and endangered species list.
Northern Redbelly Dace	G5S3 ST/S2 for South Dakota	Has not been documented on Custer Gallatin.	Not identified for SCC due to not being present on Custer Gallatin. If planned inventory efforts document presence on Custer Gallatin and these populations are important to persistence of the species future SCC listing is possible.
Sauger	G5S2	Has not been documented on Custer Gallatin. Has been documented adjacent to a FS admin road on the Ashland district.	Not identified for SCC as Custer Gallatin lands do not provide habitat for this species. The Forest Service administrative road that intersects occupied habitat doesn't appear to have any population effects.
Sturgeon Chub	G3S2S3 ST for South Dakota	Has not been documented on Custer Gallatin.	Not identified for SCC as Custer Gallatin lands do not provide habitat for this species.

Species Name	Conservation Ranking	Distribution in Plan Area	Rationale for evaluating and not identifying as Potential Species of Conservation Concern
Frigga Fritillary (butterfly)	G5S1S2	Documented on Custer Gallatin lands.	Not identified as SCC due Custer Gallatin lands being at the southern extent of its range and appears to be globally abundant especially in Canada.
Gillette's Checkerspot (butterfly)	G3S2	Not documented on Custer Gallatin.	Not identified as SCC as Custer Gallatin appears to be at the eastern extent of this species range.
Gray Comma (butterfly)	G4G5S2	Not documented on Custer Gallatin.	Not identified as SCC because it is globally stable, though rare locally likely due to lack of inventory.
Striate Disc (mollusk)	G5S1 S2 for South Dakota	Documented on Custer Gallatin.	Not identified as SCC due to being globally stable. Increased inventory efforts would likely lead to increased local abundance.
Berry's Mountainsnail	G5T2S1S2	Documented on FS lands.	Not identified for SCC due to being widespread globally and further inventory efforts would likely demonstrate increased abundance locally.
Ottoe Skipper (butterfly)	G3G4S2S3 S2 for South Dakota	Not documented on Custer Gallatin.	Not identified as SCC due to Custer Gallatin being on the very western extent of this species range and does not provide the tall grass prairie habitat this species requires.